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LAPP BRIDAL COUPLE.

Vol I.

UNDER THE RAYS

OF

THE AURORA BOREALIS:

IN THE LAND OF THE LAPPS AND KVÆNS.

BY

SOPHUS TROMHOLT.

ORIGINAL EDITION,

WITH A MAP, AND 150 ILLUSTRATIONS, PORTRAITS, DIAGRAMS, &c., FROM PHOTOGRAPHS AND DRAWINGS BY THE AUTHOR.

EDITED BY

CARL SIEWERS.

IN TWO VOLUMES.—VOL. I.

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PREFACE.

By the present work the Author has the honour to present himself to the British public.

Some thirty years ago he lay crying in his cradle in the little village of Husum, in Schleswig; the first years of never-to-be-forgotten youth were spent in "the Little Land by the Sound," and the last score of his years have been passed amongst the mountains of Old Norway.

Although he cried in the cradle—and who does not?—his principle is that life has more bright than dark sides, and that although it sometimes rains, sunshine follows.

As to his personal appearance, he begs leave to refer those curious to his portrait as he appears on the last page of this work.

So much for *personalia.* And now a few words on behalf of the book which he ventures to lay before the reader.

It is not a scientific treatise, nor a novel, but merely a modest narrative of a year's sojourn in the distant regions of Ultima Thule; not related with pedantic prolixity or tedious erudition, but sketched, as far as in his power, with light and rapid strokes. At the same time, the Author trusts that the reader will not throw away the book in disgust because he finds it lacking

the brightness, or interest, of other travelling accounts he has read, but will peruse it to the end, as it deals with a land and a race amongst whom the ordinary traveller but rarely sets foot, or, at all events, but rarely has an opportunity of spending the long, dark Polar night.

On the other hand, the weirdness of Nature in these regions, and the peculiar characteristics of the fast-dying race of only nomads in Europe, may well claim a few moments' attention.

It was as participator in the work of the International Polar Research Expeditions of 1882–83 that the Author visited the most distant regions of the European continent. His task was to effect observations of the remarkable phenomenon known as the Aurora Borealis, or Northern Lights, and, principally, in conjunction with the Norwegian station at Bossekop, in Finmarken, and the Finnish one, at Sodankylä in the very heart of the wilds of Finland, to effect measurements for determining the height of the phenomenon above the earth's crust.

He chose, as the most favourable spot for his researches, the lonely and desolate Lapp settlement of Koutokæino, far beyond the pale of civilisation, on the Russo-Norwegian frontier.

He took with him thither a photographic apparatus, by the aid of which the light in these high latitudes has delineated the accompanying illustrations, which may contribute to enhance the interest and promote the instructiveness of the book.

As regards the former, he may be permitted to point out, that they form the sole complete collection of its

kind in existence of life, people, and nature in the Land of the Lapps and Kvæns.

The map which accompanies the work does not claim absolute geographical accuracy, particularly as far as the interior is concerned, as no official survey map of these regions exists. It was drawn by the Author from the most reliable sources, and is intended only to serve as a guide map for the reader.

With reference to the spelling of Lappish and Finnish words and names, the Author has, in this instance, deemed it most practical to adhere to the mode followed by the Teutonic race, as far as it permits, as the Lapps and Finns have letters and articulate sounds foreign to any other tongue; while where objects have a Norwegian as well as a Swedish denomination, the former has been adopted, but this does not apply to *geographical* names.

With these explanatory remarks of introduction, the reader is presented with 'Under the Rays of the Aurora Borealis.'

SOPHUS TROMHOLT.

Vincent Brooks Day & Son lith

LAPP BRIDAL COUPLE.

Vol I.

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When I said just now, that it always rains in Bergen (and on this subject I may meet with sympathy from the dwellers in the British Islands), it was, of course, with *licentia poetica*, as the meteorological tables tell us that it does not rain or, at all events, only spits for about 100 to 150 days of the year. Yes, it may even happen that a man desirous of a stroll may leave his umbrella at home for an entire month, and I may mention that it was such a phenomenon which some years ago allured me into contributing a modest article to one of the Bergen dailies: "No more rain in Bergen." For my indiscretion I had to endure chaff from friend and foe, and, to crown it all, the next day Jupiter Pluvius began to open his sluices with a perseverance and determination which caused even the amphibious Bergener to turn his eyes to the East in despair.

If all the water which pours into Bergen in a twelve-month remained, not a single soul would be alive by Christmas, as during that space of time the heavens deposit a layer of water close upon six feet in depth!

If you wish to visit Bergen, do not go on a rainy day when the clouds lie dull and heavy with rain over the house tops, and when the whole atmosphere is a mass of watery dust. Bergen will then remind you of a tipsy man just saved from drowning.

But only enter the town on one of the hundred days, when the ladies exchange their umbrellas for the sun-shade! Then you will find the remarkable old Hanseatic town of Norway, nestling between its seven mountains, attractive and interesting enough. Within this frame, unpretentious and poor in appearance, you will then

discover vistas so full of beauty and originality that not a town in all Scandinavia can boast their equal.

The eye is constantly attracted by the motley crowd of peasants who throng the long, narrow *Strandgade*, Strand, where it seems as if the Norwegian peasants possessing the most vivid and picturesque National costumes had met by appointment, while the mind rests with interest and delight on the busy commercial life teeming in the harbour, the streets, and on 'change. And, should the visitor be fortunate enough to visit one of the pretty, bright villas which peep smilingly from the verdant surroundings of the town, he will find that kind-heartedness and hospitality are but little affected by six feet of water, but seem, in fact, like the flora of the town, to thrive doubly thereon. And, though I admit that the environs of the town cannot bear comparison with those of some other towns in Norway, one need only travel a few miles to alight on scenery which would excite enthusiasm in the most *blasée* nature.

In the Bergen's *Stift* all the beauties of nature which Norway possesses in various localities have been concentrated in one province: here may be found the grand, the wild, the imposing as well as the lovely, the soft, and the charming features of nature blended together in perfect harmony. Yonder you have the magnificent falls, the snow-white glaciers, the lofty mountains—and before you, verdant fields charm the eye in pleasing contrast with the pensive fjord and the restless brook. What tourist has not heard of the two famous fjords, the one south the other north of Bergen, where nature has so

lavishly expended her gifts: the imposing Sognefjord, the soft, dreamy Hardangerfjord?

And these charming bits of scenery have this advantage over those in southern climes, that they lack the varnish of modern civilisation, viz., "Grand" hotels, waiters and "tips."

But our journey is to the Land of the Lapps!

During the first part of the route, when steaming along the coast of Norway, we catch but few glimpses of the magnificent nature which hides in the deep fjords. Nearly everywhere in the south of Norway the shores are barren and uninteresting, for on one side of the narrow channel, which runs along the coast right away from the Swedish frontier, by Fredrikshald, nearly to the North Cape, lies the mainland and on the other a regular chain of islands and holmes forming a bulwark against the ocean. This chain is the *Skjærgaard.* Right or left the view is equally monotonous.

It is first when the little village of Florö lies behind us that we first encounter an interesting point on the route, viz., the grand mountain of Hornelen. Almost perpendicularly its granite wall springs from the ocean to a height of more than three thousand feet; the steamer passes right under it, and threateningly it rears its head above us with weird forms and juttings, which change their fantastic appearance as the vessel moves onward.

A few miles further north we have Norway's most western promontory, Stat, of which few travellers can speak, as the absence of the protecting Skjærgaard here exposes the steamer to the full fury of the Arctic Ocean, which drives most people to rueful reflections on the

littleness of human nature in the recesses of the frail craft. Three times I have had the honour of passing this terrible promontory, but each time I have been unable to see it, for the above-mentioned reason. I therefore trust to be excused from describing it.

When, after some hours, Stat is passed, the route lies again for a long time in the quiet waters behind the Skjærgaard, and now the poor sufferers in the clutch of Neptune creep feebly on deck to inhale the soft, fresh air.

Little as I know of Stat, I can say no more of the next town where we call, Aalesund. Some straggling houses line the harbour where we cast anchor, but as these can only accommodate some sixty souls, those of the remaining 5,540, which we are told the town boasts, must be sought elsewhere. More attractive is the next town, Molde. As a busy ant-hill greets the wanderer in a lonely forest, the little town hails the visitor from behind the broad, fertile shore with its foliferous trees. It nods smilingly to the lovely forest-covered islands dotting the mirror-like fjord, nods, too, to the sombre Alpine peaks, the Romsdalsfjælde, whose lofty mountain range encircles this magnificent panorama. In the mountains cone follows cone in perfect order, some showing weird outlines, others dotted with white patches of glittering snow.

But we have not time to dwell long in this inviting spot; only a passing glance may we cast at the attractive views which greet us on our lengthy journey by the coast. We hasten onward; but still one feels inclined to envy the seventeen hundred inhabitants of Molde, who have such a view before them every day.

Some hours' steam further, and we are in Christiansund, a kind of miniature Venice, as the town lies on three islands, between which little steamers and boats ply. Each of the islands is fearfully hilly, for which reason the houses have been laid wherever possible, but the well-meant attempts to make streets ought rather to have been confined to the cutting of stairs. But a lively, bold commercial life teems on sea and land, and the town boasts a wealth and prosperity, attained by its great export of *Klipfisk*, salt fish, to Spain, which is excelled by few towns in Norway.

We continue the journey, and speed past mountains and barren islands, between which the ocean is seen from time to time, until we arrive in the broad Trondhjemsfjord. A couple of hours after we are in Trondhjem, Norway's largest town, after Christiania and Bergen. Here the steamer stays some time, which enables us to have a look at the town.

I must really confess that Trondhjem surprised me. Some years ago I had seen the town under a three-days' steady downpour with the temperature near freezing-point; it formed then but a cheerless, unattractive picture. How different was the impression of the three sunny autumn days of my last visit, while the steamer lay moored in the harbour! The broad, cheerful streets planted with trees on both sides, under which one feels as if they had smiled benignantly on one's youthful frolics; the rich and magnificent surroundings of the town, which make the visitor forget that he is in the "Land of Stone" and within two degrees of the Polar Circle; the gleam of historical romance which the famous old cathedral and the fortress

But accompany me on an excursion from Trondhjem! Through green, undulating hills, such as are rarely seen in North Norway, past inviting villas with floral gardens, between close hedges where the mountain ash proudly displays its purple berries in tempting clusters, runs the road to the imposing waterfall, Lerfossen. Twice the river Nidelven plunges over the precipice, forming the two remarkably pretty waterfalls some hundred yards apart. The upper fall parts into two arms; a big saw-mill has been built alongside one of them: the sun's rays, which, from the bed of the ocean, lifted the drops, now ground into snowy froth, are here made productive of labour—of money.

One day I was rowed out to Munkholmen, the old fortress on a rock in the fjord, which is connected with one of the darkest pages in Scandinavian history. Here in a lonely, narrow cell lingered for eighteen terrible years (1680–98) Christian V.'s famous minister Griffenfeldt, a statesman whom all Europe had honoured as the most gifted of his age. What was his crime? The historical Muse sadly droops her head in silence. Only the wounded vanity of a weak sovereign and the intrigues of those who envied him caused Griffenfeldt to fall from the eminent position which he had attained by the brilliancy of his genius in so remarkably short a time—to fall into the most terrible misery. What inhuman cruelty to condemn this fertile brain to inaction, to slow death, within four bare walls! It was like depriving the gifted painter of his hands, the famous singer of his voice. Justly the great statesman exclaimed, when, on the scaffold, the messenger brought the tidings of the

when the ocean outside is lashed into fury, the passage in the inside channel is as calm as on a river. When, however, the islands now and then disappear from the coast, a closer acquaintance than one desires is made with the terrible Arctic Ocean.

The first day after leaving Trondhjem we pass a terrible bit of open sea, viz., the notorious Foldenfjord. As soon as the last island is passed the steamer begins to roll. The passengers hasten, pale and trembling, down into the saloon or lie down on the deck. Suddenly one is lifted aloft, higher and higher, then the vessel seems to lose her equilibrium, and she plunges into the trough of the sea with a swiftness which makes the very marrow creep. It creaks and cracks in every bolt. The lamps sway wildly to and fro; another mountain wave, bump, bump,—downwards into the watery abyss. B-r-rr-r-r—have we struck? No; it was only some chairs precipitated down the floor below. Four individuals on the hurricane deck, who a few hours ago proudly boasted that no sea would affect them, rush at this moment, as by one impulse, to the starboard side to confer with Father Neptune. In the saloon sighs come from one, crying from another cabin, while the children squeal in chorus in every variety of tune. Another tremendous sea; the ladies scream, a fearful noise is heard in the passage outside, and a chaos of boxes, portmanteaus, bundles, and parcels sweep down the floor. And in all this misery the terrible fear creeps into the strained mind: of the vessel striking one of the thousand "blind" rocks with which these waters are studded, an occurrence by no means uncommon.

In a few hours the rolling and pitching ceases, and then also the worst sufferings of those below, who soon find peace in sleep. When they awake we are in smooth water. We laugh at each other's fears, forgotten are the sufferings and the anguish, and the whole seems as if an every-day occurrence.

The steamers, which all the year round run from Hamburg or Christiania, along the entire coast right up to Vadsö, are large and commodious. The *cuisine* is excellent, there is every comfort on board, and the officers and crew are the kindest and most obliging of men. But fancy what a terrible voyage it must be in the winter, when the sun for weeks, yea months, does not rise above the horizon, and the moon and the feeble Aurora Borealis alone lights the dangerous path in this labyrinth of islands!

In the light summer days, however, when sea, mountain, and fjord are clad in their most attractive attire, then the voyage is a tour on the Rhine, on a grand scale, only the former lasts as many days as the latter hours.

The first part of the journey from Trondhjem is not very varied, it is but the same change of mountain and fjord, fjord and mountain, as in southern Norway; but further north the scenery becomes more grand, the contours more striking. Dig a canal right through Switzerland, and steam down it; that would give some idea of the voyage along the coasts of Helgeland, Lofodden, and Finmarken.

We have no longer the rounded, cupola-shaped mountains which characterise southern Norway; here, on the contrary, the mountains raise their giant forms boldly

to the sky, with pointed cones and profiles as sharp as the edge of a saw. Every step northwards brings fresh and more surprising forms into view: now *bizarre*, then fantastic; here threatening, there smiling. One giant clothes his body from cone to base in the close evergreen cover of the fir, another is content with the snow-white cap on his weather-beaten head. Here a roaring mountain-stream plunges down the steep side, yonder a glacier shoots its greenish-blue arm majestically into the valley.

For four or five days one picture surpasses another in rapid succession. There cannot be a question of even enumerating all the points of interest which pass in review, but I will briefly describe some of the most striking.

The first town we reach after leaving Trondhjem is Namsos. It consists of a cluster of houses gathered around a big church. The houses are, as in most Norwegian towns, wooden, and look very neat and attractive, while the streets run at right angles, through the disaster, or fortune, of being totally destroyed by fire in 1872. As there are only seventeen hundred residents in the town, whom it would be unreasonable to demand should disport themselves *en masse* in the broad thoroughfares, the few stragglers one meets, as well as the town, seem very uninteresting. I have searched in guide books for something interesting about Namsos, but in vain. This may perhaps be one point of interest. I know no other.

We now pass the island, Leköen, with the Lekö-mö, a mountain, of which tradition relates a romantic tale,

length of 500 feet, the walls are rather smooth and perpendicular, but the floor is very uneven. The diameter varies between 60 feet at the eastern entrance and 250 feet at the western.

How did Torghatten get this hole? It was thus.

The "Hestmanden," the Man on Horseback, who now stands as a giant in stone up yonder by the Polar Circle, and whose acquaintance we shall presently make, had contracted a violent attachment for the Maid of Lekö, Lekömöen. But, alas! his love was not returned. Then the despised lover, as is often the case in real life, became terribly enraged, and decided to obtain by force the love which she would not voluntarily yield him. The Maid of Lekö fled in terror. The Man on Horseback follows in pursuit, and shoots in anger an arrow after the maiden, but her brother—another giant—seeing her danger, comes suddenly to her rescue. He throws his hat before the arrow, which penetrates it, and saves the maiden. At that moment the sun rises, and all three are turned into stone. So they stand to-day. The "Hestmand" from his lofty saddle looks disconsolately over the wide, wide, heaving ocean, the hole in the riddled hat I have just described, and the arrow stands pillar-like on one of the adjoining islands. It is a "Bautasten."

In this manner the popular imagination has infused poetical life into the remarkable stone colosses which here in the vicinity of the Polar Circle raise their fantastic forms towards the sky.

Next comes the lovely Alstenö, with its imposing line of mountains, "De syv Söstre," (The Seven Sisters,) a grand body of seven stiff-necked stone maidens.

Our illustration depicts only the central peaks, of which the ones furthest north and south attain a height of 2800 feet.

Finally, far away to the left, we see Hestmandöen with its interesting mountain Hestmanden, the Man on Horseback, perhaps the most remarkable rock formation on the whole coast. It is the "Commandatore" from *Don*

DE SYV SÖSTRE (THE SEVEN SISTERS).

Giovanni, on a grand scale; proudly the horseman sits on his gigantic charger with his mantle fluttering before the wind; far and wide his eye scans land and sea, while boldly he lifts his hand above the storm-driven clouds.

The Polar Circle passes just across the Hestmand. Those among us who for the first time entered the Frigid Zone had, in accordance with time-honoured custom, to

"stand treat." In a sparkling glass of "Pale Dry" we toast the Polar Circle. A *naïve* young lady asks timidly, whether the "Circle" is laid on land or sea. "No, *Fröken*," said one of the sailors gravely, "it lies at the bottom of the sea."

For the benefit of those who have not been north of the Circle I must say, that there seems no difference in

HESTMANDEN (THE MAN ON HORSEBACK)

the surroundings north and south of it. We, at all events, found none, unless it was that both nature and weather became more attractive. Come and see for yourself, is my request to those who read these lines with doubt. Nobody will regret the journey, in fact, I doubt whether any other trip in the whole of Europe will repay a tourist as well as this.

It will not be long before this route will become one of

perfectly calm here. Those, however, who are able to remain on deck, will never forget the view of the Lofodden Islands, which, when approached, seem to grow bolder in outline, and their fantastic forms to stand carved on the dark background. But particularly beautiful is the broad fjord tinted by the purple glimmer of the midnight sun, when every object is bathed in *couleur de rose*, whilst whales and porpoises enliven the emerald-coloured sea.

Lofodden consists of myriads of islands of all sizes and shapes, divided by narrow sounds, through which the tide sets with great force, forming very dangerous currents, of which the most celebrated is the Malström.

It is around these islands that the great cod-fisheries of Norway take place every winter.

I will attempt to describe the peculiar life and scenes which may be witnessed here during that season.

Off the outside, i.e., the side facing the Arctic Ocean, of the Lofodden Islands, there are a few "banks," but, the very dangerous waters and the mountain-high seas render the pursuit here exceedingly precarious, while the harbours of refuge are so few that only a limited number of boats find employment here. In all there are on this side of the islands hardly more than 700 boats—"pulled," as the Norwegian term runs,—and the whole catch rarely exceeds five million cod. On the "inside" of the islands, the sea is, however, much clearer and calmer, while the harbours of refuge are innumerable between the little islands where the "Boder," the dwellings and curing lofts of the fishermen, have been erected.

From the most southern promontory of Lofodden and, northwards for a distance of about fifty miles, the sea-

bottom gradually slopes downwards from 250 to 400 feet, and at the latter depth a broad rocky ledge, the bank, runs along the whole Lofodden shore. This is the emporium of the North Norwegian, his field and his shop, from which his family and house is supplied, and without it Nordland and Finmarken would boast few other inhabitants than seals and sea-birds.

Beyond this bank again—nearer the mainland—is another one, but being nearly twenty miles from shore it is little frequented.

Soon after Christmas the dwellers in Lofodden begin to ascertain if the cod (*Gadus morrhua*) have come under the shore, and the first fish are greeted with the greatest delight, as promising an abundant catch. The great shoals do not, however, appear until the end of January, and even then they do not come all at once, but some in February and some in March. At the end of March the cod begin to spawn, and during this tremendous process the sea is quite thick and coloured. The fish now become very restless, and rush in thousands into the nets; during this period the takes are very large. Early in April the cod begin to leave the shore, the fishermen following to the southern islands, where the fishing is continued until April 16, when the fishery closes.

I said that the fishermen residing in Lofodden begin already early in January to look for the cod, but the non-resident fishermen do not put in an appearance until the end of that month. By Christmas there is, however, a great stir in the huts of the fishermen who live away from Lofodden. Tackle and gear are carefully trimmed, the provision boxes filled, and clothes mended.

Finally there is only one more thing wanted, viz., fair wind. Some want it from the north, others from the south, and to please everybody it would have to blow from every point of the compass in a week. At last it is favourable. The boat is launched, everything brought on board, the last farewell wafted to the dear ones on shore, whose eyes anxiously follow the little craft, which now runs for Lofodden.

Right away from Tromsö, and even the North Cape, down to Stat fishermen come in thousands, braving the terrible open ocean and the winter storms in their frail undecked boats, to take part in the great fisheries at Lofodden. The hardy Norwegian, however, thinks little of such a trip, and when he becomes old and unable to go to sea any longer, he may be seen often enough gazing after the departing boat with an ardent wish at heart of being able to go only *once* more, while the lad in the stem looks wonderingly at the lofty, weird mountains under which, perhaps, both his father and grandfather found a watery grave

But the Lofodden fisherman is, nevertheless, well equipped for his long journey. His long narrow elastic boat, with her spare tackle and the single, great, lug-sail, is very easily handled when the squalls come sweeping down the mountains like big, black clouds, and lashing the sea into froth seem as if they would carry boat and crew away, while these lithe, undaunted men, who ever since they were in their teens have learnt to know every rock and reef along the whole coast, possess every quality which experience and coolness can muster in battle against the raging elements. But in spite of this

many a fisherman goes to his rest in the ocean, and many an unhappy family thereby loses its only support. Sometimes the tidings of the boat with father and six sons having "gone under" at Lofodden may reach the wife and mother in the lonely hut on the shore, but often she only learns the terrible tale when the fleet returns in the spring. One by one the boats glide by the ness on which the widow stands with her little ones at her skirts. Only *the* boat is not there! Nobody has any news of it. Softly and quietly she scrambles the hills with her youngsters, scans the sea with her shading hand to light upon the well-known sail. It is nowhere to be seen. Then the widow and the fatherless little ones silently creep hand in hand down the mountain ridge. They know that *Far* has "gone home."

At the Lofodden fishery a number of Lapps also muster from the fjords on the mainland; they are considered splendid fishermen. The costume of the "Sea" Lapp, as he is called, is remarkably picturesque: a snow-white or grey woollen frock ornamented with red or blue braid, and girthed with a coloured sash, and on the head a blue, pointed, cap bordered with red.

The fishermen who do not live in Lofodden generally carry on fishing with five pair-oars, and only the true Lofodden fishermen employ less. The boat is built of Norway spruce or pine, and is so frail that a single man can bend it. She carries only one mast and little tackle for her single big sail. The crew consists of six men, of whom the one at the tiller is the "Hövedsmand," he is captain, helmsman, and pilot in one.

At the end of January the whole fishing population

is generally assembled in Lofodden. It is estimated that some six thousand boats participate in the fisheries, and allowing five men per boat, some 30,000 fishermen must be employed here.

But one asks, how can such a number of people find quarters on these barren islands?

Nearly everywhere where a bay or tiny fjord cuts in, or where the holmes offer a harbour for the boats, a trading booth has been established, around which a group of little huts called "Rorboder," fishermen's boat-houses, are clustered. Such a place is called a "Rorvær," and the traders in Lofodden are generally also the owners of the "Rorvær," the dwellings and the curing lofts of the fishermen.

The "Rorboder" are small, one-storied, wooden huts with turf roofs and a "Svale" or half-covered verandah, wherein nets, lines, and gear are stored. Inside the hut, which generally has an earthen floor, a row of bunks run along both walls, which are but scantily supplied with straw, and a sheepskin, which the fisherman brings with him. In the middle of the hut is the hearth, through the smoke-hole in the roof a bit of the sky is seen, while through the single little window with the tiniest of panes one looks on to the nearest "Rorbod." In such a hut from six to twelve men are quartered, according to circumstances; but how they manage to find accommodation in this small space can only be understood by one who has experienced the necessity of stern economy. I leave to the imagination of the reader to picture the state of an apartment occupied by so many men, the atmosphere in it, &c. It may be wondered that men can live in such quarters;

but the fisherman is perfectly content, he knows no better accommodation.

As soon as day breaks the lads prepare coffee, and when it is ready the fishermen rise. In great haste they consume the hot fluid without any solid food, and with only a ship's biscuit in the pocket and a keg of water in the boat they start for the banks. It is a splendid sight to see the fishing fleet go to sea: from every "Vær" boat follows boat, and soon the sea is covered with sailing craft as far as the eye can reach. As soon as they reach the nets the sails fall, and they lie see-sawing in one immense single line. Later in the morning most of the boats return to the "Værs" with the fish taken in the nets during the night, and when the mid-day meal is over the preparation of the fish begins. The head is cut off, the entrails are taken out, and the liver and the roe laid in separate barrels. In this condition the fish are either sold to the smacks, which come to purchase, or hung on wooden rails for drying. Towards evening the fishermen again go out and set the lines for the night. When they then return to shore each one takes a fine cod in his hand, walks over to the booth of the "Kjöbmand," the general purveyor, and, flinging the fish on the counter, demands a "Dram," a gill of corn brandy, and a scone. The cod is the true "coin of the realm" in Lofodden.

Sometimes the weather may be fine in the morning when the fleet goes to sea, but, as day advances, one of those terrible storms which costs so many lives springs up. In East Lofodden such an occurrence is not so dangerous, as the bank is here surrounded by islands, where refuge may be found with any wind, but in West Lofodden it is

fraught with great danger. This is particularly the case when a nor'wester squall drops down from the mountains. If the squall should be so violent and swift that the boats cannot be pulled under shore, or beat up against it, there is no other course, if life is to be saved, than to run before it across the Westfjord! But a journey of fifty miles in an open boat on a dark winter's night, when the hurricane whips the sea into a white, drifting froth, when a bit of canvas as big as a napkin may sail boat and all into one of the mountain-high seas—well, that is a journey which is undertaken only in the direst need, and few survive it.

Not a year passes without the sea demanding its sacrifices during the fisheries, and a couple of boats' crews are reckoned as only a small tribute. In certain years, however, great calamities occur through hurricanes, which are for ever remembered by the survivors. In February, 1848, such a calamity happened, and the hardiest fisherman still turns pale when that day is mentioned. How many sturdy fishermen went down in that gale has never been ascertained exactly, but it cannot have been far short of 500; in a single parish in Lofodden seventeen wives became widows at the same hour!

The tackle used for fishing in Lofodden are floating lines and nets, and only the poorer fishermen, who are unable to provide these, use bottom lines and hook. Each net is from 100 to 120 feet in length and 12 feet in width. Twelve to sixteen nets are joined end to end, and form a chain of nets, which is set close to the bottom in a line from the shore. In order that the nets shall remain straight, stones or lead are fastened to the bottom border

and wooden clogs or air-tight glass balls to the upper one, which thus floats on the surface. At each end, again, of the chain a long rope is attached with a big stone at one end, which prevents the net chain from drifting with the currents, and in the other a piece of wood, which, floating on the surface, tells the fisherman where the net stands. The floating lines are long, slender cords along which baited hooks have been fastened at intervals. A line with 400 hooks is termed a "Stamp," and several of these are knotted together, and laid out in a similar manner as the nets. Both nets and lines therefore lie parallel to each other: from the shore seawards.

In favourable weather the ordinary catch per boat is about 400 fish, but very often more are taken, sometimes even from 1200 to 1400 per boat. As, however, one boat with five pair-oars only loads some 800 fish, two journeys have then to be made.

Most of the fish is hung on "Hjælds," wooden rails, for drying. The "Hjæld" consists of two long poles, laid parellel, resting on solid posts, between which thin sticks are laid cross-wise at intervals. On these sticks the cod are hung in pairs, tied together by their tails, and so far apart that a free circulation of air is permitted throughout. Everywhere on the islands, where space permits, such "Hjælds" are erected, and on arriving at the fishing place one need not ask whether the catch has been great or the reverse, as that is demonstrated in the most unmistakable manner by the full or empty rails.

Great quantities of the cod are also sold fresh to the smacksmen and others, who salt it. Hundreds of

smacks are yearly equipped from the districts around Trondhjem and Bergen for this trade, and most of them also carry all those necessaries of domestic utility which the fishermen require, so that the liveliest barter takes place during the fishery. During March and April the "Værs" are real fairs. There is a bustle and noise here perfectly alarming, but the screech of the million gulls, which follow the cod, and give a strange

FISH ON "HJÆLD."

animation to the whole scene, is heard above it all. The raw fish are either salted in barrels on shore or in the hold of the smacks, which, as soon as the cargo is full, set sail for the mainland, where they are spread out on the rocks to dry, and subsequently come into the market under the name of *Klipfisk*, "rock" fish. This is the salt fish eaten in England on Ash Wednesday.

At the beginning of April the fishermen prepare to

depart, and by the middle of the month there is hardly a strange boat here. But the appearance of the place when they have left! And the smell! Around the fishermen's huts it is absolutely impossible to walk, while by the shore one can only get along among heads and entrails in sea-boots. But habit is second nature. The owners of these tenements have for years inhaled this polluted atmosphere, and, if only the catch has been great, they gladly put up with such "little unpleasantnesses" as it brings.

In June the last act of the fishing drama is witnessed. Towards the middle of the month the dried fish are taken off the rails, and from every quarter boats and smacks arrive to take away their share. Now, too, a number of vessels come from the southern towns laden with all kinds of goods, so that even on this occasion a lively exchange takes place.

The traveller, who during the summer steams through Lofodden, gazing on nature here, the "Rorboder" and the "Hjælds," with or without fish, may, perhaps, with a dash of imagination, form some sort of idea of what the life here is like in the winter, when every ness swarms with fishermen and the sea teems with boats; but it is, I am afraid, only an imperfect picture of the reality. But that these regions, apart from the grand scenery, are worthy of being visited in the summer any one will admit who pays a visit to Stokmarknæs, one of the innumerable trading stations or marts in the Lofodden Islands.

Here are seen the bevy of boats which are so characteristic of these parts: those peculiar skiffs with the

broad, square sail, and the arched prow, which reminds one of the Norse Viking galley. The "Hjælds," full of fish, are on the flood half under water, steamers convey merchandise to and fro, while in the background tower the Alps of Arctic Norway, with their lofty cones capped by glistening snow.

The herring fishery also creates a momentary stir in these parts, and sometimes the catch is very large, as, for instance, in Eidsfjord, near Stokmarknæs, where in one year, from August to December, 300,000 barrels of herring were taken.

We now take leave of Lofodden, but still continue for a long time to enjoy the magnificent view formed by the island mountain wall and its shapely peaks. We journey through narrow, smiling sounds, which remind one of the famous Hardanger: green birch groves and fertile, flower-laden fields alternate with neat farms and opulent trading stations set in a frame of lofty mountains. The panorama varies as we proceed. Now the wild and imposing predominates, now the soft and beautiful, and here both are blended into pleasing harmony.

I will however not tire the reader by enumerating names and details, but I only wish I could place before you some of the magnificent views unrolled before our gaze. These parts are, however, never visited by the artist or the photographer, and the steamer passes too quickly for their delineation.

In latitude 69½° N. lies a little fertile island, low in height compared with its gigantic surroundings, but covered to the top with the most verdant green and a

copious flora, and on which lovely villas peep from charming birch groves. At the foot of the hill, along the narrow sound separating the island and the mainland, lies Tromsö, the largest and most important town in North Norway, and the last on our road to the Land of the Lapps. Only some ninety years old, Tromsö has, through enterprise and favoured by successful herring

VIEW OF TROMSÖ.

fisheries, risen to a prominent position, and boasts some 5,500 inhabitants. Animated and active the town is, no doubt, still, but it is only a shadow of what it was some years ago. At that period gold seemed, so to speak, to rain into the little town, great fortunes were made simply by a stroke of the pen, there prevailed a luxury here which was unknown in any other town in Norway, and the people even christened their town "Paris of the

North." But too much champagne was drunk, and, when the feasting was at end, the crash came: the great financial crisis, the embarrassments, and the bankruptcies. The town received a blow from which it never recovered, and the "Parisians of the North" have now to work as hard as other mortals for their daily bread.

We employ the few hours the steamer stops here to pay a hasty visit to the museum, which is of great interest to a stranger, as it is composed almost entirely of objects from nature and life in the Arctic regions. We walk through some of the long, broad streets with the small unpretentious wooden houses, and accompany two of our travelling companions, Catholic priests, who have voluntarily left sunny France in order to work as missionaries among the Alten hyperboreans, to the convent by the pretty little chapel, where we are introduced to their worthy colleagues; but the steam-whistle sounds; we must on board.

We again glide past the lovely, smiling island encircled by the chain of giant mountains, and further and further north goes the journey, but, nevertheless, nature remains the same, wild and imposing, and the weather equally fine, and even when we reached the highest latitude north, 70½° by the island of Loppen, where you gaze straight into the Polar Ocean, there lay such a smile over the blue-green sea and the summer-clad shores that one might have fancied oneself on the shores of the Adriatic.

In the Öxfjord, while the magnificent mountains and silvery glaciers were tinted with the soft ruddy glow of the setting sun, I said good-bye to the steamer on which

I had spent so many happy hours since leaving Bergen, as she had to continue her journey along the coast of Arctic Norway to Vardö, and went on board the little steamer which plys on the Alten fjord; and during the wonderful night, when the Aurora Borealis, as if to welcome me, begun to festoon the sky with many-hued draperies, reflected in the deep, silent waters, we glided softly in between the jet black, sombre mountains, towering on both sides of the fjord, to our welcome haven.

THE CATHOLIC CHURCH IN TROMSÖ.

CHAPTER II.

BOSSEKOP AND ALTEN.

An Oasis in the Far North—The Church of Rome in Ultima Thule—The Bossekop Fairs—Scientific Reputation—The International Polar Research Expedition, 1882–83—Their Work—Remarkable Contrasts of Temperature in the Arctic Regions—The Norwegian Circumpolar Station at Bossekop—Midnight at a Circumpolar Station—Science Calls!

Gentle reader, do you know where Bossekop is? No! Well, if you will kindly open the map, and examine the northernmost parts of Norway, where the jagged shore is washed by the icy waters of the Arctic Ocean, you will, in the neighbourhood of the North Cape, light on the name "Altenfjord," and, if you will follow this to the bottom, you will see "Bossekop," in the southern corner. This is the spot where these lines were written, and which lies in latitude 70° north, i.e., about 1500 miles from the North Pole.

I think I can imagine what idea you have formed of this place, its life and conditions: a rugged, barren shore of rocks along which all the winds of the globe struggle for supremacy, a sterile, stony soil, too poor to sustain even the lowest flora, yard-deep snow on land, towering icebergs on sea, a population of wretched, half-starved Lapps, wrapped in furs from head to foot,

lingering in dirty hovels, and flocks of ravenous bears and wolves—in short, Cold, Darkness, Snow, Storm, Wretchedness, Poverty, Discomfort. Isn't this, now, the picture you have drawn to yourself of Bossekop?

No, such Bossekop is not. Picture to yourself a small bay, lovely as one of the highly-praised lakes of Italy, dreaming, smiling in the balmy summer air, which has not the heart to ruffle the crystal surface, and surrounded by a wreath of green, grey, and brown mountains with soft outlines; picture to yourself a beach where the fine white sand forms a level floor where the sighing swell plays with the weeds, the pebbles, and the shells, with a background of blue mountains whose crest glitters in eternal snow, and add to this a valley which is lost in the distance, through which a river winds between hills and forests, while the sun-rays glitter in the waves between birch-trees and firs; a fine broad table-land over which you may roam for hours between gigantic firs purpled by the setting sun, where a little white church lies in idyllic rest in the midst of the forest nature, and where every glade abounds in gorgeous wild-flowers and tempting berries. Picture to yourself a little village of bright villas, inhabited by people whose hospitality and kindness are as lavish as the nature in which they live, a deep blue sky from which the sun shines day by day, ornamented with clouds the forms of which are unknown to the Southerner; and finally, add to it all the grand, enigmatical play of flames, the Aurora Borealis, licking the heavens night after night with hardly a moment's pause, with a force of colour and beauty of form seen nowhere else in Europe—can

you fancy all this in one picture, then you have a true idea of lovely Bossekop.

You will, no doubt, be surprised to hear that here, so far north, so much is found which belongs to southern climes and so little of that which characterises the Polar regions, and I hasten to confess that nobody was more surprised than myself, when I first set foot in the Land of the Lapps; in fact, I may say that my whole journey thither was one series of surprises. I knew, of course, that the coast of North Norway is climatically more

VIEW OF BOSSEKOP.

favoured than any other part of the globe in the same latitude, and was aware that the northern part of the Scandinavian peninsula boasted scenery of remarkable beauty; still, in spite of this, I admit that it was with a certain feeling of uneasiness I started on my journey to the North, as I expected, for every degree I proceeded, to have to say good-bye to conditions and habits of life to which I had been accustomed since childhood, and that every step northwards would bring me further into a world of privation and discomfort.

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THE CHURCH IN ALTEN.

But how entirely different my experience has been. My whole journey has been one of pleasure, while both the mode of living and the conditions of life I have met with here, have been so little different to those I had been accustomed to, that I at times might have fancied I was journeying to the South instead of the North, and that I sojourned in one of the Alpine valleys of Switzerland or Italy instead of the northernmost inhabited regions of the Old World. Lavishly has Nature expended her gifts in this spot in Ultima Thule, so lavishly that the traveller doubts whether the 70th degree of latitude really crosses it. If we follow it east or west, around the Pole, we should everywhere encounter cold and bleakness—nowhere the soft beauty which smiles on the beholder from the landscape where the broad Alten river embogues, delta-like, into the waters of the fjord.

Climb only once the steep, white slopes of the Sandfald, in Alten, one of the numerous terraces of sand which Nature has formed here, and behold the warm, rich scene which is unrolled before your admiring gaze, whether turning to the flat, sandy shore with projecting shoals the offspring of the river and the fjord, or following the long, fertile valley, where the river meanders between forests and meadows or to the blue mountains yonder. How charmingly rural the little village of Elvebakken is, inhabited by industrious Finns, immigrated from the Duchy of Finland, or as they are always called by the Norwegians, "Kvæner," whose huts lie peacefully in the midst of green fields and fir-forests. Alten is the northernmost spot in the world where corn ripens. And how romantically the farms along the valley are situated

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THE CHURCH IN ALTEN.

among the brooks and tiny lakes. It is difficult to believe that the waves of the Arctic Ocean wash the foot of the slope.

The Alten river is one of the richest salmon streams in Norway, and was for many years rented by the late Duke of Roxburghe, who used to spend a few weeks here every summer. Since his death it has, I believe, passed into the hands of other wealthy Englishmen.

On the road to the Sandfald lies the somewhat imposing Altengaard, Alten manor, formerly the resi-

THE CATHOLIC MISSION-BUILDING IN ALTEN.

dence of the "Amtmand," or chief magistrate, of the province of Finmarken, but which is now occupied by the Catholic Mission which has its residence, church, and school here. This is one of the northernmost strongholds of Catholicism in the world. The Faith has, however, here, as in the rest of Norway, gained few proselytes, and one the more respects the brave priests, who, far away from their native land, so earnestly devote their energies to what appears a profitless task.

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VIEW FROM THE SANDFALD, IN ALTEN.

Near the bay which has given the village and entire adjacent district its name—Bossekop being the Lappish word for whale-bay—lies quite a little street of small houses. This is the northernmost market-place in the world.

Generally the place is deserted and the houses empty, but twice a year, in April and December, it teems with a

THE MARKET-PLACE AT BOSSEKOP.

varied and interesting life. Then the great Bossekop fairs are held, flags and bunting fly from every pole, and the houses are transformed into booths. Norwegians, Lapps, and Kvæns gather here, to buy and sell, and a motley crowd of characters in wonderful costumes and with strange tongues throng the place in the semi-darkness of the winter's day. Goods are turned into money,

money into goods, and when the fair is over the croft is again deserted and the houses empty.

Bossekop boasts also, scientifically speaking, a classical reputation. It was here that the French scientific expedition under Lottin and Bravais sojourned in 1838–39. This expedition, whose object was to study the physical conditions of North Europe, and which was most excellently equipped, collected by diligence and skill a remarkably complete and very important scientific material. Here the excellent studies of the Aurora Borealis were effected which are without equal for their accuracy and completeness, and here too were the splendid drawings of the aurora made which are found in the great work, 'Voyages en Scandinavie,' &c., in which the results of the expedition are detailed. These illustrations have never been excelled in beauty and correctness, and I intend in another chapter to give some reproductions of them.

There are certainly few places which can rival Bossekop as regards favourable conditions for the study of the Aurora Borealis. The zone in which this phenomenon is most frequent and attains the greatest development runs thus right across this part of Norway. This applies also to the other phenomena of terrestrial magnetism.

It was these considerations which made the Norwegian Government decide on establishing their circumpolar station at Bossekop in 1882.

As is generally known, a number of such stations were maintained by various countries around the North Pole, in order to effect, during the period August 1, 1882, to

September 1, 1883, a series of exhaustive researches of the physical, viz., meteorological and magnetic, conditions of the Polar regions, and as this scheme marks an epoch in the history of Science, and the writer's journey to the North was directly connected with the same, I venture to give a brief account of it.

During the present century many attempts have, as we know, been made to penetrate into the Arctic regions, and the fruits of these expeditions have certainly not been few. But they seem chiefly to have been of geographical importance. Many data bearing on certain branches of science have, of course, been gathered, principally in those which can, to a certain extent, remain satisfied with isolated researches, as, for instance, zoology, botany, and geography, but those branches of science which embrace the study of periodical phenomena have not reaped that harvest from these expeditions which might have been desired. The leading object of such expeditions has been either, to get as near the Pole as possible, or to find the routes around the two great continents—the North-east or North-west passage—whereby the result of the same has chiefly been an extended geographical knowledge of these regions,—in fact, a mapping of the continents, which is also, of course, of great importance; but nevertheless the collecting of physical material has been secondary. The observations which we possess have nearly all been made in one locality, and are, therefore, of secondary value for the study of physical science. On the other hand, the observers of most expeditions have not been specialists, which circumstance has naturally prevented us from obtaining the

most accurate and exhaustive reports of the observed phenomena. It is, however, perfectly obvious that these earlier expeditions were of immense importance, as from them the scientist has learnt that the key to many a problem in meteorological, magnetic, and electrical science must be sought in the Arctic regions; and this discovery had the effect of creating a desire among scientists to obtain a complete and exhaustive series of researches, on the physical phenomena of the lands around the Pole, extending over a twelvemonth.

In 1875 a Commission was formed in Berlin to frame a plan for future German explorations around the Pole. It was already apparent, that, if any result of value was to be obtained from such expeditions the geographical researches would have to be separated from the physical ones. No steps were, however, then taken, as the German Government did not sanction the necessary funds.

The Commission also proposed to establish two stations, viz., on East Greenland and West Spitzbergen, from which expeditions should be dispatched by sea to the North. Later on the suggestion was advanced in a far more complete form by Weyprecht, the celebrated commander of the *Tegethoff* and the discoverer of Franz-Josef Land. He developed fully the idea of separating the geographical expedition from the physical, and it is his plan which has now been carried out, but only, it may be regretted, after the gallant explorer's decease.

His plan was to establish a chain of international stations, or temporary observatories, around the Pole, which were laid so that they could be reached without difficulty during the period of occupation. They should

be fitted with the best scientific instruments we possess, principally for the study of geo-physical science, and be in charge of specialists; and, finally, the observations should be effected throughout an entire year, in order to obtain a complete record of the annual periods of the geo-physical phenomena, which hitherto was not in existence, as nearly all observations referred to the winter period. The stations should be established on a common basis, and possess, as far as possible, instruments of similar construction, and worked in the same manner. This latter suggestion was of great consequence, as the results therefrom would be uniform, which they could not be where each observer followed his own method and ways of observation.

By degrees Weyprecht's plan advanced, although slowly. In 1879 it came before the International Meteorological Congress in Rome, from which it was referred to another assembling the following year in Hamburg. Here the representatives of those countries which were willing to participate in the plan met. The plan was adopted in the main, but did not advance, as first one, then another, country began to raise individual objections, and it seemed at times as if the scheme would fall through. At last, however, at the Congress held in St. Petersburg in 1880, under the presidency of Prof. Wild, the plan was accepted by all countries. During the above-mentioned period eleven stations were maintained. There should have been twelve, but one was not established, as I will presently explain.

The United States maintained two stations, viz., one at the most north-western point of North America, Point

Barrow, and another at Lady Franklin Bay, in Smith's Sound, both of which were constructed to carry on the observations for three clear years. They were taken possession of a year before the others, and the observations were to be continued a year after the latter were closed. England, in conjunction with Canada, erected her station at Fort Rae, on the Great Slave Lake; by Cumberland Sound, in Baffin's Bay, Germany established hers; while Denmark selected Godthaab, in Greenland. In the Arctic Ocean Austria selected Jan Mayen and Sweden Spitzbergen for their quarters. Norway selected, as I have mentioned, Bossekop, Finland Sodankylä, in the heart of Finnish Lapland, and Russia raised two, one at Novaya Zemlya and another at the mouth of the Lena. The twelfth station, that of Holland, was to have been formed at Port Dickson, in Siberia, to act as a connecting link between the two Russian stations which lay so far apart, but, as is generally known, the Dutch failed to reach Port Dickson, and were frozen in in the Kara Sea, where their vessel, the Norwegian steamer *Varna*, foundered.

The observations which these observatories were called on to prosecute around the Pole, were meteorological, magnetic, electrical, and auroral. I will briefly refer to the meteorological ones, which may, however, be said to have been the least important, as it is evident that to obtain exact records of the weather in the Arctic regions during one single year, even from a variety of places, is not of much consequence, as the year during which they were made may have been a normal one or, equally, as far as we know from experience, an abnormal one. We

are unable, it seems, to tell whether the year 1882–83 was one or the other.

In order to give an idea of the variability of the weather in the Arctic regions I may mention that the annual mean temperature of the atmosphere of Jakobshavn, on the west coast of Greenland, during twenty-five years has shown a variation of from 14° to 27° —i.e., a difference of 13°. And, if the winters only at Jakobshavn are examined for the same period, we find that the mean temperature of one was – 0·6° and that of another 19·4°, i.e., a difference of 20°. It is also impossible to calculate as to the weather conditions in one place from those which prevail in another. Thus, while the winter 1880–81 in Iceland was very cold, perhaps the coldest for some centuries, as the temperature was greatly below the average, the mercury freezing in the bulb in North Iceland, it was very warm in West Greenland—considerably above the average. The winter of 1881–82, again, was mild in Iceland, but with a cold spring and summer; but this same winter was very severe in West Greenland, so severe that the first vessels which arrived in the spring from Denmark could not reach the harbours on account of land ice. Consequently, places which lie so near each other as Iceland and West Greenland, may simultaneously experience the most opposite weathers, and one single year's observations in these localities may therefore be considered of secondary value to meteorology. Lately another method has been largely followed by students of this science. It consists in making daily a chart of the atmospheric conditions then prevailing over as large a tract of the globe as possible, and from these charts

deductions are made as to the probable origin and development of atmospheric disturbances, &c. This method, applied to the circumpolar observations, and at the same time followed at the permanent meteorological observatories in North Europe and the United States, will doubtless enable us to obtain a comparatively complete idea of the weather conditions prevailing simultaneously over a large portion of the earth, and also to ascertain the manner in which the atmospheric conditions of the Arctic regions affect our own.

What results we may ultimately reap from this method it is impossible to say at present. It is expected that they will be of considerable value, but, as I have previously stated, the meteorological observations at the stations were not the most important. They were nevertheless, of course, furnished with every instrument applicable to this science.

The most important observations were, beyond dispute, the magnetic ones. The observers had, in the first instance, to effect as accurately as possible absolute measurements of the declination, inclination, and intensity of the terrestrial magnetic currents at the various stations. It was decided that the declination and inclination should be determined correct to a minute of a circle and the intensity with three exact decimals. But this is in itself not of most importance, as it is clear that some of the stations may have been somewhat unfavourably situated in this respect, as, for instance, near iron lodes. The absolute measurements may therefore be of minor importance; but when the spots in which these observations were made have been accurately fixed, future expeditions

—and there is every probability of the plan being again carried out in a few years—will possess excellent statistics for the determination of the secular variations to which the three elements of magnetism are subjected. What the observers should principally determine was the variations of these elements which are measured by the so-called variation instruments. They are three in number, and each one is observed through a separate telescope. One shows the variation in the declination, and the two others the variations in the vertical and horizontal intensities. The variation observations are also necessary for effecting the absolute measurements, as the needle is in the Arctic regions so restless that everything depends on the moment when the absolute measurements are made. If they are, for instance, made at an unfavourable moment the observer may obtain a figure deviating from the true value several degrees, as the needle, when oscillating, will at times swing upwards of five degrees to either side; it is therefore necessary to have a variation instrument in operation which shows the oscillations, in order to reduce the absolute determination to its correct figure, the perturbations causing the error. These perturbations or irregular alterations of the position of the magnetic needle are of great importance in themselves. It may be known to many, that there is a phenomenon in nature called a "magnetic storm," which is noticed even in our latitudes, as, on certain days, the needle suddenly becomes very restless and swings far out of its usual position. These magnetic storms have for a long time engaged the attention of scientists, and attempts have been made to demonstrate that they occur

at the very same moment over the entire surface of the earth. Other theorists seem to think that the storm travels in a certain direction. It was the solution of this problem which engaged the circumpolar observatories more than any other, as in the Arctic regions they occur far more frequently than with us. It is necessary to ascertain, whether perturbations in declination, inclination and intensity occur simultaneously over the earth, or only a portion thereof, or travel in a certain direction.

Magnetic observations are exceedingly difficult to effect in the Arctic regions, partly on account of the restlessness of the needle, partly by the comparatively small horizontal intensity, and, finally, through the great inconveniences of the cold. The observations must be effected in a building entirely free from iron, the absolute measurements in a separate room, the determinations of the variation in another. All currents of air in the room must be avoided, which is very difficult in those regions. The three instruments of variation must be examined every hour throughout the twenty-four hours, and each observation be the average of three, at least, as one single one would, on account of the great perturbations, be very misleading. In addition to this, observations were made at the stations twice a month—on the 1st and 15th—every fifth minute throughout the twenty-four hours, and on each of these days observations were further made every twentieth second for one hour, a task requiring great skill and labour. These demands were made in order to ascertain exactly, whether the perturbations are only local, and for the same reason it was decided

not to make these observations according to local time but perfectly synchronally. The time of Göttingen, in Hanover, was chosen as the common one for all the observatories.

Next in importance were the auroral observations, but of these I intend to speak fully in another chapter. Finally, the observatories studied the electricity of the atmosphere and certain other matters of purely scientific interest, to which I shall, however, not refer here.

It will thus be seen that the work of the French *savants* at Bossekop referred to was resumed in 1882 by a skilled staff of Norwegian observers, and Bossekop will once more have her name inscribed on the historical rolls of science.

In order to give the reader an idea of the work and life at these circumpolar stations, I venture to give a description of the Norwegian one at Bossekop, in charge of my esteemed friend and colleague Dr Aksel Steen.

On the arrival of the expedition in June, 1882, the first work was to effect some magnetic researches on the bare ground, in order to ascertain whether the spot chosen had any disadvantages, as for instance iron lodes; and, as soon as this was found in order, the buildings were erected. For perfect magnetic observation it was necessary, as I have indicated above, to have two rooms, at the same time separate and combined, viz., a larger one for the diurnal variation observations and a smaller for the absolute measurements, which were made a few times a month. The rooms must be separate, so that one instrument does not affect the other, but they must at the same time not be more distant from each other than

the observer in the one can easily signal to his colleague in the other, as simultaneous observations in both have to be made.

At the Norwegian station the arrangement was as follows. The variation chamber was made rather large, in order that two sets of instruments – one as reserve —could be placed therein, and was laid, partly, under the ground, the earth dug out being cast up against

THE NORWEGIAN CIRCUMPOLAR STATION AT BOSSEKOP, LOOKING WEST.

the outside wall and covered with turf. This gave the chamber quite a subterranean appearance. The object of this was to keep the temperature as constant as possible, a matter which is of great importance in these researches. Of windows there were none, but light was obtained by means of four lamps, burning day and night. From the variation chamber a ladder leads, through a small aperture in the western cross-wall, up into a passage which

opens, at the further end, into the chamber for the absolute observations. From this again a door leads into the open. In the passage a thin wall has been made to prevent, as far as possible, air currents and changes in the temperature. The hut is built of common deals, and as the presence of iron disturbs the observations the use of this metal has been entirely avoided. Not a single iron nail has been used, the structure being joined by means of wooden pegs and the fire-proof roofing fastened with copper nails. The lamps were swung on brass wires, the hinges of the doors made of the same metal, and the latches of wood. Everyone must, before being permitted to enter these "sacred halls of science," divest himself of keys, knives, and any other article of contraband, while the "high priests" themselves even had their clothes made with horn buttons instead of metal, and those who were near-sighted used always gold spectacles in reading the telescopes.

In the variation chamber eight pillars were erected, of iron-free bricks, running free into the earth, which at the top carried a marble slab, on which the instruments were placed, viz., one on each of the six, and the two telescopes, by which the instruments are read on the two others.

The little astronomical observatory lies in an open spot, to the west of the magnetic hut. The roof and the walls to the south and north are fitted with shutters, which may be opened for observing the passage of stars through the meridian. On a solid pillar in the centre stands the transit instrument.

The thermometers were, for protection from the sun's

rays, placed in the usual manner in sheet-iron box, and this again in a wooden cage resting on four high poles. The cage was fitted with venetians, instead of walls, a double back-wall and roof, and the construction of both permitted the free circulation of the air. The barometers and other instruments were placed in the residence of the chief, where also the office, work-room, &c., of the expedition were situated.

For the study of the Aurora Borealis a pillar was raised in the open, and on this the auroral theodolite, the instrument by which the phenomenon is measured, was placed. There were besides, other pillars erected, as, for instance, for the spectroscope, the rain and snow gauges, &c.

At Bossekop the *personnel* consisted of five men, who effected the observations in turn. The twenty-four hours were divided into four watches of six hours each; but during the so-called "terminal" days the labour of observation was, of course, greatly increased, as one man had to be posted the whole time by the reading telescopes, while another had to be in reserve.

But let us see how the hours glide by at the station in Ultima Thule!

Regular the life is. Night as well as day, in storm and calm, in snow and hail, in rain and sunshine, the scientist "on duty" walks his round. It is now near midnight. The one on duty dozes in his chair. Not a sound is to be heard in the chamber or the wilderness around, but the steady beat of the clock on the wall: dick—dock; dick—dock; dick—dock—mind the clock! —dick—dock. A winding creak, and the sonorous clock strikes the hour of midnight. The observer rouses

himself from his reverie of distant friends and places. He has ten minutes to get ready in before the midnight hour strikes in Göttingen. The fur-lined boots are put on, the fur jacket or the cloak, and, as there is a cutting icy wind about, he turns the fur cap over his ears. The cup with water, from which the wet thermometer is to be bedewed, is taken from the stove, the chronometer attached to the overcoat, a glance at the Hageman anemometer, which registers the wind itself inside, and he sallies forth. Outside a cutting north wind is blowing, which sweeps the fine crystals of snow into his face with a sensation like the pricking of a thousand needles. Out goes the lantern in his hand, and he has to get indoors to relight it. This being successfully accomplished he again ventures forth, and, with a quick glance at the sky, to see if there be auroræ about, he makes for the magnetic observatory. The lantern is left, with the water-cup above it so that the water shall not freeze, in the ante-room, while he descends into the subterranean chamber, where the instruments stand. He sits down on the wooden stool before the three telescopes, while his eye follows the hands of the chronometer by his side until the moment of observation arrives. Each instrument is read seven times, which is effected in six minutes, then the temperature in the chamber is noted, and he leaves the hut to register the velocity of the wind with a hand anemometer, which is held high into the air while the observer counts the thirty seconds in which the ball-cross fan rotates. When this has been noted, and the force of the wind judged, as well as its course by the weathercock, the extent, nature and drift of the clouds

are recorded, and the solitary "Jack o' Lantern" makes for the long-legged thermometer cage.

He carefully climbs the ladder, in order not to spill the water in the cup, quickly opens the door to the inner cage, and, by the aid of the lantern, reads the dry and wet thermometers. The water-cup is placed under the wet thermometer to keep it free from ice until the next visit. If the temperature is only a few degrees below freezing

THE THERMOMETER CAGE.

point, and there is a dry wind, it is necessary to wet the thermometer before observing, and the scientist has then to visit the thermometer cage before he enters the magnetic hut. His work outside is now finished, but if there should be auroræ visible, he has to note their position and appearance. In the office he again makes a record of the wind by Hageman's anemometer, and, to crown it all, reads the barometer.

Such is the work of the observer at a Polar station on an ordinary occasion; but between the hours of 5 and 11 P.M. his work is further increased. Fifteen minutes after every hour a special observation of the Aurora Borealis has to be made, as well as a measurement in the common plane between the Polar station at Bossekop and the auroral one at Koutokæino. If the sky is clear, and the variegated bands and arcs of the Aurora Borealis play magically between the twinkling stars, the observer has to pay a visit to the auroral theodolite. He then effects the measurements, and makes notes on a sheet of paper laid on a pane of glass forming the front side of a box in which the lantern is placed. This arrangement enables the observer to read what he writes with the greatest ease; but when it is considered how quickly it has to be done, and the hands being benumbed with cold, it is not to be wondered that these records sometimes present the most extraordinary caligraphic puzzles, the key to which is possessed by the writer alone. They are, however, as quickly as possible, entered clearly into the auroral "log." The hour 8—9 is the true auroral hour, as for this space of time observations have to be made every tenth minute, of course, as far as the clouds and the aurora permit.

In this manner time passes here hour by hour, day by day, and the work is performed as regularly as that of a machine. The pile of observations steadily increases and figures crowd upon figures in the various logs. These are, however, laid *ad acta* for the present, but will form the solid basis on which researches and studies shall be made when the expedition returns home. What a

quantity of figures! By each one of the hourly observations no less than 100 figures are taken down, and an ordinary day represents therefore 2500 and a terminal one 6000. When to these are added those of the periodical observations, that all original ones are copied into the logs, and that all preliminary calculations require myriads of figures, it may be wondered that the observers are not attacked by softening of the brain. But there is no fear of that. The work has been most carefully divided both as regards time and individual, and the days glide pleasantly by, while the columns grow imperceptibly.

I trust that my scientific gossip will not cause the reader to throw away this work in disgust, but induce him to follow me through the Land of the Lapps.

I have in the foregoing ventured to give an idea of the important international scientific work carried out in 1882–83, and the valuable results we may in time expect from the same. I have also given an account of the beautiful Bossekop, and in a few days I am off to a place which I believe not many tourists, even Englishmen, have visited, far away behind the mountains yonder, viz., Koutokæino, a Lapp district down by the Russo-Finnish frontier.

The object of my visit to this place, is to contribute my share to the study of the Aurora Borealis. The journey is certainly not an inviting one, as there is no trace of a road. The first two days one travels on horseback high up across the mountains, then a few days by boat up the Alten river—on all sides a deserted and uninhabited country; but duty calls, so to horse and forward!

CHAPTER III.

FROM BOSSEKOP TO KOUTOKÆINO.

Encountering Troubles—The Mail in Lapland—We Start at Last—A Dreary Ride—A Surprise in the Finmarken Wilderness—"Little" Jossa—A Sad Landscape—A Refuge on the Mountain—Another Dreary Ride—A Strange Camp—Donning Lapp Dress—On a Lapland River—A Fatiguing Journey—A Weird Night-scene by the River—Oil! Oil! Oil!—A Pleasant Night—My First Visit to a Lapp Tent—Arriving at my Scientific Goal.

I had to wait nine whole days at Bossekop before I could start on my journey. Nine lovely days. In the day the sun shed its beautiful tint over the little bay and the inviting landscape, and at night the aurora spun its magnificent flaming net over the heaven. Kindness and hospitality greeted me everywhere—no wonder, therefore, that I left with a sad heart. But it is the sad association of travelling to meet and part, to grow fond of people and things and then to have to say good-bye to all.

I have hitherto praised everything on my journey, so perhaps it will be a relief to some that I have at last something to complain of. This is the communication in Ultima Thule. I had expected to have been able to continue my journey from Bossekop after a couple of days' stay, but this was, I found, out of the question.

Could I be allowed to join the mail whenever that might leave, I ought, I was told, to consider myself very lucky. The principal difficulty in starting seemed to be, that the boat, in which the last two days' journey was to be made up the Alten river, belongs to Koutokæino, and had, therefore, to be ordered a considerable time beforehand to be in its place on the river when wanted. The mail is stated to leave for Koutokæino "every fortnight"; I had therefore hopes of getting away on the Saturday, but Saturday drifted into Sunday and Sunday into Monday, from day to day its departure was postponed, as it could not be "made up," I was told. It was nearly midday on Wednesday before we got off, and then the mail started without waiting for us.

It was quite an imposing caravan which left Bossekop that morning. I was obliged to carry with me a great deal of luggage, half a dozen large, heavy packing cases, &c. The good Bossekop folks shook their heads at the sight of these tremendous chests, declaring that it was utterly impossible to transport them the long way across the mountains; but I told them I must bring them *coûte que coûte.* Eventually I had to be content with half of it, leaving the rest to some future opportunity.

With the exception of a short distance there is no other road than the one nature has made across the mountains. No carriage can therefore be employed, and everything must be carried on horseback. I was in despair about my boxes—some of which I had to repack into smaller compass; but this was out of the question with such as that containing my beloved auroral theodolite. I found, however, to my relief, that the

back of a horse is capable of resisting more than it is given credit for, and we succeeded, after a good many difficulties, in placing it so that we could proceed.

At last we set out with my belongings on six horses, in pairs, all loaded like the true "Ship of the Desert." The "Lensmand"—sheriff—at Koutokæino, whose company on the journey I was fortunate in obtaining, remarked to me, that never before had he seen horses so heavily laden on this road, and he doubted whether he ever should again.

The first part of the road on leaving Bossekop is remarkably lovely, and one fancies one's self in South Norway. The road runs through a splendid forest of firs and birch-trees, and is as level as the best high-road. It is undoubtedly a road unequalled in Northern Norway. The sun throws its rays over the attractive scene from an azure sky, dotted with dazzling white cumulus clouds: they play between the tender leaves of the birch and the pointed needles of the fir, with the rippling wavelets of the river, which on our left winds between green fields and yellow sand-banks, envelop the Raipas ridges in soft, rich colours, and veil the contours of the distant mountains on the horizon in a light-blue, dreamy haze.

It is Summer in its full, luxuriant glory which holds sway in the Alten valley, but we have not travelled many hours before we reach the frontier of her dominions and enter those of Autumn, covered in fast fading colours. The birch-trees become fewer and fewer, smaller and smaller, and clad in yellow leaves: yellow and brown in every *nuance* are the tints which henceforth shade the landscape.

The excellent broad road through the forest lasts for about five miles, when it comes to an end, as abruptly as a half-finished sentence. Hence we proceed down a steep hill to the Eiby river, which a little below joins the Alten river. The former is, like the latter, very broad, but rather shallow, while a number of islands of sand and stones divide it into several channels. We cross the river: the water comes up to our feet. Again the physiognomy of the road changes; we now travel through a wood of low, close birch-trees. Every moment a box bumps against a branch or a stem: every trace of a road has disappeared, and we have to choose our path where we think best.

Now we climb down a long, steep sand cliff, one of those so common in these parts, where the horses sink down over the hoofs in the loose *débris;* a wrong step and horse and rider would be precipitated into the river which rushes foamingly beneath. Then we trudge for a long while by the side of the river over a desert of boulders. Thus we journey in constant change of scene; we have a specimen of every kind of soil: now stone, now sand, now woods, then a swamp or a river, uphill, downhill, and on level ground. Of human beings or their habitations we see hardly any, until we pass the Eiby river. At times we pass a cow, which bellows to its comrades in the underwood, and the whole flock comes galloping up to stare in surprise at our strange caravan.

One after the other the heavily-laden horses walk, carefully feeling their way, each led by a boy from Alten; on the last I am seated, and by my side walks the Crown's representative at Koutokæino, who, with Lapp shoes on

his feet and a Lapp staff in his hand, shortens the road with agreeable talk of things and people in the distant, lonely spot whither we are bound.

Hour after hour goes by, journeying through endless tracts of forest land. At the roots of the trees quantities of gigantic mushrooms proudly raise their bright heads; here and there stand clumps of wild flowers, the last remnants of summer, while the setting sun dyes the green, yellow, and russet foliage with warm, purple colours.

When leaving the farm *Vina*, which belonged to the

THE "HOTEL" AT GARGIA.

Duke of Roxburghe, the ground becomes worse than ever; it is no longer hills we have to climb, it is natural (and most troublesome) terraces in the barren mountain, pleasantly varied with boggy moorlands. It was with a great sense of relief indeed, that we, towards evening, reached our first night's quarters, the mountain hut Gargia.

With the denomination "mountain hut" I had associated something very uncomfortable, something à la Lapp "Gamme." But instead of a wretched, empty hovel I found, to my surprise, at Gargia a neat little

house containing several rooms, which were not at all uninviting. There was "mine host" and hostess too, in

JOHANNES ABRAHAMSEN MOTKA—MY TRUSTED COMPANION AND FRIEND.

this little hotel in the Finmarken wilderness. Soon a roaring log fire blazed on the hearth, and I must confess,

that the supper served from our own stores was almost worth the fatiguing journey. We had both *café noir* and toddy before we sought rest on the magnificent reindeer skins with which the "bunks" along the wall were softened.

At dawn the next morning we were astir. Nature

YOUNG LAPP FROM KOUTOKÆINO.

is, by-the-bye, rather attractive in the vicinity of Gargia; the fir and the birch rival each other in covering the surrounding slopes, while rivulets moisten the green fields.

Our party had been augmented by three Lapps, who desired to get to Koutokæino. Two of them are the mail-carriers, who left Bossekop a little before us, and who carry the heavy mail-bag which every fortnight gladdens

the hearts of the residents of the remote Koutokæino with news from the Great World. One of them I beg permission to introduce at once, viz., Johannes Abrahamsen Motka, or, as he is generally called, "Little Jossa." *

He became afterwards my trusted companion and friend on nearly all my excursions from Koutokæino. A true and honest fellow.

The third is a young Lapp, born at Koutokæino, who has through poverty been compelled to spend the summer as a fisherman at Hammerfest, but now returns home. A fine, lithe figure in his picturesque costume.

On leaving Gargia we begin at once to climb the mountain, Beskades, on whose level back we shall journey the whole day. The vegetation becomes poorer and more scanty, and when we reach the true high plateau it disappears entirely. Hour after hour I ride across a waste so sad, so lonely, and bleak that my pen fails to give an adequate description of it. Not a trace of animal life, and only the poorest vestige of a flora. Wherever the eye turns it rests on a dull, level flatness; a yellow-brown pattern on a yellow-grey background, and, by way of a change, the reverse of these colours. The grey is formed by the finely woven leaves of the reindeer moss, and the brown by a species of birch, dwarf-birch, whose stunted stem and round leaves, the size of a sixpence, rise only a few inches above the ground.

Thus the landscape passes in review, in silent desolate

* "Jossa" is the Lapp corruption of Johannes. The Lapps receive Norwegian Christian names when baptized, but use the Lappish equivalent to each other.

monotony. Not a sound falls on the ear, only now and then the oppressive stillness is momentarily broken by the tinkling of a horse bell, or an encouraging shout from one of the men to the heavily-laden horses.

About six hours after leaving Gargia we reach the

A HALT BY THE "GAMME" AT LODDIKA.

"Gamme" at Loddika, the highest point on Beskades, where we halt for the midday's rest.

The whole structure contains only a single room, empty, between four deal walls, with an earthen roof. Nevertheless, I can fancy that the hut is a welcome refuge to those who may travel in these parts in rain or snow.

The burdens are taken off the horses, which are then left to find water and what grass there grows between the dwarf-birch and the moss, the provisions are unpacked and prepared, and how deliciously does the frugal meal taste in the pure invigorating mountain air!

I inscribed my name, according to custom, on the door of the lowly hut. Should you, patient reader, ever visit the spot, seek it out, and give it and the hut my hearty greeting. I shall never be able to do so again myself.

After a couple of hours' rest we resume a journey similar to that of the morning. But although we are nearly 2000 feet above the level of the sea, the air is as soft and balmy as on a summer's day down south. The tiny lakes, which we pass from time to time, show a surface as calm as a steel mirror, in which the mountains around and the golden clouds sailing above are reflected as clearly as if they were engraven on their bosom. But in spite of the fine weather the journey seems very long, and Beskades to have no end. In addition, the road is perfectly level, and bog follows upon bog, in which the horses sink to the saddle-girth. One of them rolled right over in the treacherous quagmire, and it was with great difficulty we got him up.

At last we feel we are descending, and soon a little copse of straggling birch-trees greets us with a welcome to lower regions, but we have still to journey some hours before we reach our night quarters.

It is an hour since the sun set, but even now our surroundings are clearly visible in the lovely twilight, and by the aid of this we shortly espy below us the long

following days, in a boat, pulling up a swift, foaming stream or shooting roaring rapids with a crew on board who knew about as little of my language as I knew then of theirs.

Our sleeping quarters at night would have satisfied Cromwell himself in the way of plainness. They were, four leaky walls and a roof, evidently constructed by the same architect, and a hearth. *Voilà!* But the sparkling fire and the many Lapp physiognomies grouped around it—our party had now been augmented with the boatmen from Koutokæino,—*we*—white subjects of King Oscar, all lounging around it on the fragrant birch-boughs covering the floor, and drinking the *café noir* which our merchant friend brewed so excellently—constituted, in the shifting, fanciful glow of the flames an impressive and interesting picture. For the first time on my journey I felt I had traversed the frontier of civilisation.

Having finished a very pleasant meal, and duly disposed of our "night-cap," we selected our beds on the floor as best we might. There were a good many of us, and not much space for each. The hard floor was my mattress, a "Pæsk"—the Lappish reindeer coat—my cover; this was my bed. It might have been good enough if it had not been so hard. How my limbs ached when I got up in the morning! And to increase my sufferings, I was not in sole possession of my couch!

Early in the morning the merchant awoke us, and offered us some of his excellent coffee. The weather had now become cool and the sky cloudy.

For the first time in my life I had to assume the "Komager"—Lappish shoes—and the "Pæsk." The shoes were simple enough to get into, and from the

experience I now have of them I think them preferable to modern boots; they are easy, soft, and bend at the slightest movement of the foot, while the feet are always dry and warm, whether one wades through water or snow, and it is really a delicious sensation to walk in them on the springy carpet of the reindeer moss. On stony ground, however, they are to the novice exceedingly nasty, which I to my cost experienced, when we had, in dangerous or shallow places, to leave the boat and walk some way on shore. It was practical experience of the penance of those devout Catholics who walked with peas in their shoes to expiate their sins.

But the "Pæsk," this thick furry bag with a hole for the head and two for the arms, closed up back and front, I could at first not manage to get on. I got half-way into it right enough, but the hole for the head I could not find, and when I felt for the arm-holes they seemed to be in the most perplexing places. At last I got an arm in, but then I lost my spectacles and all became darkness; however, by the aid of a kind hand I managed in the end to get both arms through, and then the head. When I finally got it on, I felt as I might fancy I should with a hot flue all around me. But I hasten to do homage to the unknown inventor of this ingenious piece of dress; with this on one can brave an Arctic winter with perfect equanimity.

We now said good-bye to our guides and horses, who returned to Alten. It would be some time before we should see them and *horses* again.

And now began the long fatiguing boat journey, so

fatiguing that nobody, who has not performed it, can form even an approximate idea thereof.

The Lapp boat is a kind of canoe, long and narrow, with high pointed stem and stern, so that the gunwale in the middle is nearly flush with the water. A Lapp stands in each end, now pulling now punting it along, while the passengers squat in the middle; there are no seats. This is the sole means of travelling on the waters of the Land of the Lapps.

We were three boats in company going up the river. This stream, which runs the whole way from the Finnish

A LAPP BOAT.

frontier to the Alten fjord, is exceedingly changeable in its course. Here its surface is as clear and tranquil as the most sheltered lake, and there it rushes along in foaming rage over boulders and down rapids, so that the boat is on the point of being carried away by the force of the swirl. Soon it expands into a broad, silvery lake, and soon it dwindles down to a tiny stream between high banks. In some places it forms magnificent falls, and in others it becomes so shallow that the boat every moment scrapes the bottom. It is, therefore, no easy matter to be skipper here. But it is

delightful to see the skilled hand and quick eye with which the Lapp steers it through all these difficulties, and more fascinating still to stand on shore and watch the boatmen, at each end, in their picturesque, almost fantastic costumes—the many-coloured coat fluttering in the wind, and the gaudy cap thrown jauntily on one side of the head—shooting the slender craft through the foaming rapids.

The troubles of the traveller are, chiefly, that he has every moment to leave the boat and walk long distances on shore, as the current in many places is so strong, but the water so shallow, that the heavily-laden boat cannot get up without. He must then not be particular whether he has to cover sand or stone, ford a stream or two, or jump a ditch at the peril of his life. If the traveller is, however, clad as I partly was, in Lapp's dress, the journey is gone through with comparative ease.

The landscape here is everywhere the same; very strange and very monotonous. On both sides of the river rounded mountains or sand cliffs rise to no very great height, which as far as the eye can sweep are covered with undersized birch-woods tinted with all the splendid colours of autumn. Here is every shade of colour from green to brown.

Mile upon mile is covered, and one day ends as the previous. The landscape remains the same; it is the same view in the morning as at night; the same faded, monotonous picture. It seems sometimes really as if we had not moved from the spot.

The straggling birch-copses and the moss are the only signs of life on these wastes. Only on very few occasions

a wretched Lapp farm or an empty, solitary "Gamme" is met with. At noon one day we entered such a farm by the river, and I had the first opportunity of seeing some sides of Lapp domestic life, which are peculiar and very interesting to the traveller. I will, however, reserve a description for a future occasion.

We journey on, and in the afternoon reach the most dangerous spot in the river. It is the splendid, imposing waterfall which the Norwegians call Storfossen (Great Fall) and the Lapps, Neidogortsje. Here a boat cannot get up, and not even the salmon is able to jump it. This fish is therefore not found in the river beyond the fall. We have to unload the boat, and carry both that and luggage some way up the river, where the reverse operation has to be gone through. For some distance we were unable to put the big boxes on board, on account of the dangerous state of the river. They had all to be carried on the back of the Lapps, who "worked like niggers." It was a terrible task for us all.

With this the day had advanced so far, that it was out of the question to attempt to continue the journey over the dangerous part before us that night, and as there were no human habitations within miles, we had to accept the inevitable, and pass the night in the open on the shore.

A large bonfire was lighted, and around it we all squatted—Lapps and Norwegians, men, women, and children. And now a coffee-brewing on a large scale took place; we had eight big kettles going for a good hour. It is marvellous what quantities of this fluid a Lapp can consume.

When I looked at the weird, but picturesque group thus encamped around the fire in the dark night, I almost began to fancy myself removed to some other earth. The great, lurid flames, with a column of black smoke ascending high into the air, the knots of people around, with strongly-marked physiognomies, clad in fantastic costumes, the bustle and stir to satisfy the cravings of hunger, was indeed a fit subject for a painter. And how lively was the talk, in the strange but sonorous tongue, which my two Norwegian companions, of course, spoke fluently. What animation in the laughing, noisy, joking, eating, and drinking groups!

The weather had the whole day been threatening; grey, heavy masses of clouds had, indeed, increased the depressing and monotonous character of the scene; but it was not until we were encamped by the fire that rain began to fall. This was a pleasant prospect for the night, without tents!

Under such circumstances a glass of toddy would have been most acceptable to all of us, but our little stock of brandy had unfortunately "run out" the night before. The worthy sheriff and myself had in the course of the day several times exchanged glances at seeing the attention the wily tradesman bestowed on a small keg of very suspicious appearance, which, when questioned, he coolly declared contained—oil. We, of course, laughed at the joke, and were in hopes that at night we should be permitted to pronounce upon the quality of the "oil." When night came, he, however, persisted in his assertion that it was oil. Nothing else. And, as

all our most winning solicitations to tap the suspicious-looking vessel only elicited the disgusting word oil, we tried hard to persuade ourselves that the man spoke the truth. But, you cunning Son of Mercury!—you deceived us. I will tell you that your keg after all contained the desired fluid, and that you carried with you some of the finest "Three Stars" to Koutokæino. And as a punishment for your deception, and your cruelty in letting us sit freezing in the cold, damp night air, I now expose your treachery, so that you shall not have an opportunity of duping other unsuspecting travellers, when you tell them that you only carry—oil!

As getting "something hot" was out of the question, we might as well try to sleep. I crawled into my "Pæsk," put my umbrella over my head, and tried very hard to persuade myself that I was lying in a cosy, warm bed instead of in the cold, damp grass. The Lapps selected their "beds" where they thought best, and soon we were all lulled in sleep, the fire shortly after following our example.

During the night the rain increased, and I laid listening to its patter on the umbrella. I thought with despair of my things by the river, covered only by a piece of canvas. There were many important things which might be damaged. There lay my chronometer, all my photographic plates, which the slightest damp would destroy, and I could only console myself with the consciousness that I had done everything in my power to have the instruments transported to my destination, and had watched over them with the greatest care ever since they left Bergen.

Very early the next morning—I believe about three o'clock—we were astir, the fire being re-lighted, and soon the eight kettles were again at work. Shortly after we were again "under weigh," now by boat, now on foot. It was the same landscape, the same falls, the same lakes as yesterday; the same coffee, the same exertion, the same sky for fourteen long hours.

The only time we halted during the day was to pay a visit to a solitary tent inhabited by a Lapp family. We crawled into the narrow, dark tent, and sat down around the hearth in the middle, from which the smoke curled through the opening at the top. The kettles were again put on, and when our provisions were unpacked we enjoyed a meal in true Lapp fashion. The seat was not very comfortable, and the space rather confined, and the smoke throughout tickled our eyes, while the Lapp dogs sung duets; still, it is possible, when necessary, even to enjoy a dinner under such circumstances. Perhaps a thought creeps into the mind of how regardless and unappreciative one has been of former comforts, and, on the other hand, this primitive way of living has its special attraction as long as it possesses the charm of novelty.

The coffee has been consumed, the pipes lighted—we must again be off. When we halt next time it will be in Koutokæino.

Once more the monotonous panorama passes before our eyes. The slopes become gradually less precipitous, the vegetation scantier, and the district poorer, which I had hardly deemed possible. A flock of reindeer, belonging to one of the migratory herds, looks down from

a hill in wonder at the unaccustomed sight, as we shoot forward underneath.

At last I hear, "now we have only two miles left"—now only one. And then Koutokæino's red-painted church on a hill comes into view, a couple of houses follow, and in the next moment we set foot on the sandy shore.

Nearly a month has elapsed since I left Bergen, and I stand at the gate of my scientific goal. Happily I have hitherto passed through all dangers and difficulties, and I sincerely trust that a similar fortune may be in store for me during the long, dark, and cold winter's night which now gathers around me!

CHAPTER IV.

KOUTOKÆINO.

In the Regions of Sand—Glacial Action—Sad Surroundings—An Old Lapp Cemetery—My Quarters at Koutokæino—Lapp Dwellings—Peculiar Stores and Hayricks—Shut out from the World—Fresh Newspapers—Hospitality in the Frigid Zone—A Vicarage in the Land of the Lapps—"Spröite"—Favourable Situation of Koutokæino—Marvellous Display of Aurora Borealis—An Event in Lapp History—My Mysterious Paraphernalia—Astonishment and Terror—Photographic Surprises—Work in the Cold—Sport.

For a month I have resided here at Koutokæino, a whole month I have spent in this corner of the world, and I will now attempt to describe the life and the people here.

Koutokæino cannot by any means be called a pretty place. Grand mountains, silvery glaciers, splendid falls, verdant fields—must be sought elsewhere. But Nature in this spot has, nevertheless, a peculiarity of its own which does not render it the least repulsive. The landscape is not Norwegian, in fact it does not call to my mind anything else I have seen. It is unique. Here are no mountains, as far as the eye can reach; east, west, north, south, not a single peak or ridge is to be seen. Yea, there is hardly even a stone to be found here, and this in a land which is not poor in that article! It is the

sand which reigns supreme here. Low, rounded hills of sand cover the whole district, here and there dotted with stunted birch trees, the rest being covered with grass, heather, and moss. The river-shore forms a broad, white plain of sand, level and clean as a floor, and by its sides rise high, precipitous cliffs of bare sand.

On the hills, too, large sandfields are found as in some

FROM THE SANDY REGIONS AT KOUTOKÆINO.

places on the east coast of England. The foot sinks into it as in snow. The Polar-born icebergs of the glacial age have ground the rocks to dust.

When the wind is high the sand is whirled aloft, and drifts through the air as in the Desert of Sahara. Through it all flows the mother of the sand, the river, broad, silvery, and tranquil, but so shallow that it may nearly everywhere be forded.

Tiny lakes lie spread over the ground, in which the monotonous outlines of the landscape are reflected, while in hollows between the hills rivulets hasten on to join the big river. But no bird sings by the waterside, no flowers cluster on the banks of the brook. Autumn is nearly past. Winter is approaching. The birds have started on their long journey south, to bask in the sunbeams which make the cupolas and minarets of Cairo flash fire, to sing to the mystic Nile while the moon charges her rippling waves with glittering silver. The flowers are dead.

On the terrace, a little above the river and parallel with the same, lie three wooden buildings, painted yellow and red, and a little further off, and higher, the tiny church, also painted red. *Voilà, Koutokæino aristocratique!*

In these three houses, Lensmanden, the sheriff, the vicar, and the merchant, the only Norwegians in the place, reside. On the other side of the river stands the new school-house, a very neat building, and spread on both banks of the river are the Settled Lapps' farms or Gammer.

The church lies on a little hill, about a hundred yards from the river, on its southern side.

It is not very large, but neatly kept outside and in. It was built as early as 1701, at which time, and down to 1751, Koutokæino belonged to Sweden.

The cemetery presents, however, a sad and depressing sight. The graves can hardly be distinguished, while sand and dry leaves make sport around them. Here and there a crooked, half-decayed stick stands: the remnants of a cross. In the centre of this desolate spot stands a

group of birch trees; they are the only ones which can claim the name of tree in the whole district.

On one of the sand terraces by the river—the one shown in our illustration—lies the old cemetery, which has not been used for two centuries. A few cavities in the ground alone indicate what the place was once used for; but in the sand-bank down by the river bones and

THE CHURCH AT KOUTOKÆINO.

remains of Lapp sleighs protrude, in which latter it was formerly the custom to bury the dead. By degrees wind and weather have gnawed on the loose *débris,* and one grave after another comes tumbling down the declivity, at whose foot blanched bones and skulls lie grinning in the sun.

The houses of the three Norwegian families have quite a "European" appearance. The house in which the

merchant resides is not very imposing, but that a pleasant hour may, nevertheless, be spent within its walls, I can testify. It is long since I forgave my kind host his nasty joke with the oil.

On the roof is a peculiar structure; it is an arrangement very often seen in these parts, viz., a structure for drying reindeer meat. In the little house on the left is the shop, which contains every object and nicknack Lapp taste can desire. The merchant's house

THE OLD CEMETERY AT KOUTOKÆINO.

is now some thirty years old; its predecessor went up in flames, in 1852, during the terrible drama then enacted here, of which I will give an account later on.

The old, somewhat dilapidated, vicarage is the same which was the scene of one of the most revolting acts of this drama.

Close to the vicarage is the old school-house, which is now only used occasionally. It is a most modest hut, on which wind and weather have played so long and so assiduously that the least shock may cause it to fall in.

around it. Here, where these lines were written, the poor Lapp miscreant has to take his trial, and confess his sins before the inquisitorial "Foged," the magistrate, and two clerks, who come all the way from Alten twice a year for the purpose. If he is found guilty, and this is not seldom, as the Lapp seems to have a weakness for pilfering, he is locked up in one of the

THE RESIDENCE OF THE "LENSMAND" AT KOUTOKÆINO.

little cells above the Court, the windows of which may be seen on our illustration. They were at that time empty, and one made an excellent photographic chamber for me.

The resident Lapp population at Koutokæino only consists of seven or eight families, but this is, of course, but a fraction of the principal inhabitants in the district, viz.—the Mountain—"Fjæld"—Lapps. Thus, Koutokæino

is not only the name of the hamlet, but of the entire parish, running from the Finnish frontier in the south to Alten in the north.

The Mountain Lapps have no fixed homes, but live as nomads, moving their tents and herds of reindeer from one place to another. Just now they are wandering hither from the coast, where the summer has been passed.

Our four illustrations of a Lapp "Gaard," or farm, will give an idea of their dwellings.

The principal structure is a little wooden hut, con-

LAPP FARM AT KOUTOKÆINO.

taining a dark and dirty room and a small cot. Besides this there is a storehouse and a shed for the cows and sheep, and, finally, there belongs to every such farm a peculiar, tent-shaped structure, constructed of wooden rafters and earth, with a hole at the top and a door at the side. Here the hay is boiled with water into a kind of soup, on which the cattle are fed in the winter.

What greatly adds to the size of the farms is a cluster of little storehouses, resting on poles, one to two feet above the ground, which are called in Norwegian

"Stolpeboder." These do not, however, belong to the resident Lapps, but to the Mountain Lapps, whom they serve for the storing of such articles as they do not care to carry with them on their roaming journeys across the deserts of the North. These strange little pigeon-houses, which remind one of the Norwegian "Stabbur," form the sole fixed property of the Mountain Lapps.

Some Lapp families are, however, content with a far more primitive abode than the above. This is a so-called "Gamme," constructed of birch-trees and turf.

A LAPP "STOLPEBOD."

The whole forms an oblong hut, resembling the roof of a house lying on the ground. A smoke-hole in one end and a door at the side are the only openings. Here the family and their domestic animals live in peaceful harmony.

Near the Lapp farms there are always a number of strange-looking apparatus, the use of which puzzles the visitor. Among these are the hayricks: wooden structures, some four to six feet in height, which carry the hay on the top; they resemble, from a distance, houses

the walls of which have been removed, the roof alone remaining.

Such hayricks are found in great numbers here; and under the rick the Lapps hang their furs and other wearing apparel. On the roofs of the houses they place the basket-shaped structure in which hay and moss are conveyed home.

EARTH-GAMME AT KOUTOKÆINO.

Everywhere outside the farms one comes across the sole vehicle known in these parts, viz., the "Pulk," or, as it is called in Lappish, "Kjærris." This is a kind of sleigh, very much resembling the half of a boat. It can, of course, only be used on snow; when drawn by a reindeer it forms a most magnificent conveyance. In the summer travelling is done by water or on foot, a carriage being unknown in these parts, where there are no horses.

There are people here who have as little idea of the appearance of a horse as of an engine. All journeys are also much shorter in the winter, when the snow and ice make one high-road of the entire country.

I greeted as an old acquaintance the draw-wells on

LAPP HAYRICK.

every farm; they are exactly of the same primitive kind as those used in southern Scandinavia.

Life up here is not fraught with many variations, and amusements are somewhat limited, but if one has something to do time passes pleasantly enough without feeling that one is banished from the Great World. On the other hand, it is as quiet and peaceful here as if there were no outside world; all its noise and strife we

hear not, or, at all events, but as the echo of the battle. Only about once a fortnight a fresh breeze is wafted to us from the world without. This is when the post comes. It is the most exciting occurrence in our little world. The letters are devoured as soon as they leave the mail-bags, but the newspapers are for the time put by, as they must entertain during the fourteen long days until fresh ones arrive. Every day a paper is read, and during the fortnight we have thus a "fresh" paper every day. But it is *a month old.* To us they are just as interesting as though they were published the same morning.

One day glides by like the other; we are entirely thrown on our own resources. The faces, too, are the same. Now and then a strange Lapp face appears, a visitor from the neighbourhood; otherwise nobody comes or goes.

But apart from these restraints, we are just as happy here as the dwellers in a southern clime. In the Norwegian families the life is just the same as further south, and neither is wolf meat eaten nor cod-liver oil drunk for breakfast. The *cuisine* is in fact excellent. There are, however, a few things which the visitor has to renounce, as, for instance, beer and cigars. But then again, he has compensation for this loss in products of the land unknown to the Southerner, of which I must specially mention the reindeer meat. I must confess that it was with horror that I thought of this diet, when I was told it was the only "animal food" known here, and I had some serious thoughts of turning vegetarian for a year; but I found to my delight in a few weeks that the stuff served in South Norway under the denomination "rein-

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IN KOUTOKÆINO VICARAGE.

deer meat" has nothing but the name in common with that consumed in the north.

And how delightfully sociable life became among us Norwegians, how we gathered together in the rigid deserts of Ultima Thule! We are, with the exception of ladies and children, only three civilised beings, viz., the sheriff, the merchant—the man of oil—and the writer, as the vicar is *pro tem.* absent on the coast, and does not return till Christmas.

How often we met at one or the other's house on nights when heavy clouds hid the aurora, and I was unable to work! To give the reader an idea of the cosiness of a home beyond the Polar Circle, in the Arctic regions, I invite him to look at that of the Koutokæino vicarage. Would anyone believe that such a drawing-room could be found in Arctic Lapland?

In pleasant conversation the evening passes by, after an excellent dinner off a reindeer joint, a glass of toddy and a game of cards. "Spröite"—squirt—is the name of the noble game worshipped here; a kind of simplified whist. It was foreign to me when I came here, but with practice I succeeded in generally being the winner, to the mortification of my friends, who considered themselves experts in the game.

My reasons for choosing Koutokæino for my researches on the Aurora Borealis were these. I have already referred to the chain of international meteorological stations which were established around the Pole, and whose functions were also to study this phenomenon. But on one point, viz., the measurement of the height of the Aurora Borealis above the crust of the

earth, one of the most important, we were aware that the result could not be of much value, owing to the great distance between the stations, and their relative unfavourable position. In order to solve *the* great problem of natural science, viz., the height of the Aurora Borealis, it is necessary to have two stations lying in a direction North-South to each other, and a fair distance apart; and, as researches seem to indicate that the plane of the aurora lies between 60 and 120 miles from the earth, a distance of about 60 miles between the two stations would be the most advantageous. If from two such stations the angle which an arc of the aurora forms with the horizon be measured simultaneously, one obtains the material required for determining the height of the arc above the earth's crust. When it, therefore, was decided to establish the Norwegian Polar station at Bossekop, it became clear to me that Koutokæino was the true place where to establish the corresponding second station. Koutokæino lies in a line nearly due south of Bossekop, and the distance as the crow flies between the two is about a degree, or 63 miles. There were besides some other reasons than the above for choosing Koutokæino for my station, as these conditions might have been found elsewhere, as, for instance, at Hammerfest, and apart from the circumstance that Koutokæino is situated just in the zone wherein the auroral phenomena occur most frequently and attain their highest form of development. These were, that Koutokæino, by its inland position, would possess more favourable weather conditions than a spot on the coast, where clouds and moisture would greatly affect such observations. Finally, Kouto-

kæino had a freer horizon than any spot on the mountainous coast, an absolute condition for the study of the Aurora Borealis.

Such were the considerations which prompted me to say good-bye to civilisation and friends for the space of a twelvemonth, and go into exile in the dark, cold, and desolate regions of the Far North. In my expectations as to the favourable situation of Koutokæino, I was not disappointed, the horizon being as free as on the highest plateau in the world, and every night the marvellous play of light was seen on the clear sky. The autumn was, however, not as propitious as might have been desired, on account of cloudy weather, but it was very favourable during the winter.

In the autumn the weather was mild and pleasant, the temperature being about freezing-point in the night and about 60° in the middle of the day.

The Aurora Borealis develops a richness of colour and display of light of which those who have only seen this phenomenon in southern climes can form no idea. It is nearly always in the sky: as soon as daylight disappears it flames up, and is even transparent when the sky is perfectly obscured by clouds. It is not, as further south, confined to the northern horizon; it is seen in the zenith, and from time to time the waves of light roll symmetrically over the entire sky into the furthest corners of the heavens. That wonderful form of the Aurora Borealis known as the auroral "corona," created by beams or streamers travelling upwards from all points of the horizon and meeting in one spot in the zenith, is also seen here nightly, while another, of true Arctic character,

the streamers, attains the most marvellous forms. From one side of the sky to another a drapery, woven of light and colour is wafted; now here now there, first one then two, then several bands, one above the other, never at rest, and never the same form, hither and thither the folds sway with a soft, fascinating motion, as from one end to the other waves of light chase each other, overtaking, crossing, meeting, while the lower, intense border, displays the loveliest colours of red and green, the upper one fading into the dark background.

My presence at Koutokæino was, as may be imagined, quite an exciting event in the Lapp world, so small and monotonous; and I fancy that for a long time the tale will circulate among them of the stranger who came such a long way for some unfathomable purpose, and raised his mystic instruments in their midst. To a Lapp, with whom the events of the year are made up by winter, spring, summer, and fall, my mysterious occupation and strange paraphernalia might well cause reflection.

A little way from my residence I had, after much difficulty, raised a square pillar, a matter not of the easiest in a place where there were neither bricks, cement, nor labourers. It was therefore not of the most perfect construction. On this pillar stands my most important instrument, viz., a combination of a transit instrument and an auroral theodolite. The conic tube, partly perforated in order to offer less surface to the wind, is the apparatus by which the Aurora Borealis is measured, while the transit of the stars is observed by the telescope on the other end of the axis. It is thus of great importance that I should have the true time when the simultaneous

observations in the common plane Bossekop-Koutokæino were made. A little wooden box surrounds the instrument, which may be let down during observations.

Near to this is a cupboard in which such things as may be required during the observations are kept, as, for instance, astronomical charts, spectroscopes, &c., so that everything might be at hand. There are also stands for lanterns, a lighted glass disk for writing on, the rain and snow gauges, as well as a stand for the photographic camera, in case it should be possible to photograph the aurora. In the centre stands the writer himself, clad in Lapp costume, a dress which I assumed immediately on my arrival, as being far better adapted to the requirements of life here than that of a Nineteenth Century gentleman. The coat is light blue, of easy cut, and tastefully ornamented with yellow and red borders, with a broad belt of the same colours round the waist. On the head is the peculiar, jaunty cap, which is, perhaps, more picturesque than any of the Scandinavian peasants', with a blue, red and yellow border below, crowned by a square, blue top. The feet are encased in "Komager": pointed shoes of tanned leather filled with hay or grass—some varieties of *Carex* being most used—and laced to the ankles by long, coloured ribbons.

On the gable of the sheriff's house I raised a long pole, with an iron point at the end, which was connected with an insulated wire leading into my workroom. A similar wire was laid in the earth, in a north-southerly direction, each end of which was attached to a large copper disk, and again connected with other instruments. If these arrangements be added to the others, it was

not surprising that a suspicion became manifest among the poor Lapps that an individual related to their old *noaider*, or sorcerers, had settled among them.

During the nights, when making my observations, they gathered around me, staring in silent wonder at my actions. They would stand thus for hours.

Among my instruments there was none which attracted their sympathy so much as my photographic apparatus. Daily some of them came begging to have their *govva*—portrait—taken. They never seemed to get tired of seeing themselves or their friends pourtrayed. My greatest pleasure was to take them up into my dark photographic chamber, and let them witness the production of the portrait. Then their surprise knew no bounds, and in awestruck wonder they gazed in the semi-darkness at the birth of their own likenesses. In truth, we, who claim to know so much about the properties of light and the elements, have as much reason to watch this beautiful process in wonder as the simple Lapps; we understand it almost as imperfectly as they.

From dark until midnight, when it was not cloudy, I generally worked at my instruments. Ten minutes after every full hour observations had to be made in common with the Finnish polar station at Sodankylä, in Finnish Lapland, and five minutes later with the Norwegian at Bossekop, while during the auroral hour, viz., 8—9, Göttingen time, observations were made every fifth minute. Besides, on these occasions I studied the aurora whenever there was an opportunity, while on the two terminal days I made observations every fifth

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MY AURORAL STATION AT KOUTOKÆINO.

minute, as far as in my power, from midnight to midnight when dark.

The reader may wonder I have no account to give of terrible encounters with bears or wolves in these wastes, but on this point I am compelled to disappoint him, as bears do not exist at all in these parts, while the wolf, the arch-enemy of the Lapp, is so shy and frightened that it is hardly ever seen. Only honest reindeer and peaceful sheep roam over the sand-banks at Koutokæino, and a brace of ptarmigan, or a white hare now and then, form the only game worthy of the sportsman.

CHAPTER V.

KOUTOKÆINO IN NOVEMBER.

LAPLAND UNDER SNOW—NATURE'S SLUMBER—SILENCE, DESOLATION, DEATH—GOOD-BYE TO THE SUN—NATURE'S NOCTURNAL DISPLAY—SENTIMENTAL THOUGHTS IN MY SOLITUDE—ARCTIC COLD—MY WINTER DRESS—NIGHT WORK UNDER 50° OF FROST—WHAT DO WE BURN?—WANT OF SNOW—ALARMING PROSPECTS—REINFORCEMENTS—A STRANGE SCENE BY THE RIVER—TERRIBLE FIRE AT KOUTOKÆINO—THE MORAL.

WE are in the middle of November, and below a white shroud of snow the Land of the Lapps slumbers in its winter sleep. The poor flowers, which a little while ago basked gaily in the sun, have been scattered to the winds, and only the seed remains, buried in the hard frozen earth, longing for far-away Spring, whose gentle breath shall call them into life. The thin birch copses, which used to contribute their share to relieve the desolate landscape with a faint tinge of the colour of Hope, stand enveloped in Nature's common white garb, woven with the fine threads of filagree hoar frost and glittering ice crystals. The river, too, which spoke so cheeringly in the autumn, is silent, and bound in the iron grasp of King Ice.

Everything slumbers after the short, bright summer's day; even the wind durst not play with the snow-white cover of Nature's couch, the very air seems to sleep.

Nothing breaks the silence. You may wander for miles over the wastes, but never a sound, save the creak of your foot in the snow, breaks the silence either from heaven or earth. You may listen for a single stroke of a bird's wing, or a squeak from an animal on earth, spy for the slightest movement in the lifeless solitude—in vain; all is death.

In the south the light of dawn is seen. You wait and

KOUTOKÆINO UNDER SNOW.

wait, day comes not. At last, when nearly noon, a small portion of the sun's disk creeps above the horizon, moves a little way along the hills, and again dips down, to pay a shorter call still the next day. Again darkness gathers over the land, star after star begins to twinkle in the deep blue sky, while the crescent moon sheds a pale lustre in the southern heavens. It is only four o'clock.

But in the long night which follows, Nature shows that she is not asleep, and she unrolls before your wondering gaze a spectacle to witness which a journey to the Land of the Lapps would repay. Across the dark heavens the mystic forces spread a glimmer of light: the grand play of light, colour, form, and motion has begun. Soon the silent energy raises a magnificent tent of flames over the earth, woven of myriads of trembling streamers, which, resting on the horizon, shoot upwards to the coronal point in the zenith; and now it unfolds garlands and draperies in all the lovely colours of the rainbow, fluttering from north to south, from east to west, and a moment after, the entire heavens resemble a bath of liquid fire in violent motion. With constant change and incessant renewal, this marvellous display continues through the long winter's night until the last flickering remains of the elements of light vanish before the approaching dawn.

Thus day follows upon night. It is certainly not a very varying or exciting life, and one who had not a task to perform, would be driven to distraction by the monotony; but I myself felt little of this, as I had plenty to occupy me, and I felt nearly always content. Only now and then, when I wandered away from Koutokæino, and beheld the soft contours of the blue mountains in the distance, I felt a peculiar throbbing sensation of the heart, a craving desire to get beyond them, to the world on the other side. But this was but for a moment, as I soon persuaded myself that my journey lies thither in the spring, and I returned contented to my little circle of friends.

Only once; once only I was on the point of breaking my chains, and flying from this desolate, dark spot to the warm, bright world without. The cause was quite accidental, the effect, perhaps, comic. In an English novel I was reading. I came across a situation, in which the lovely heroine throws a rosebud from the casement of her bower to her lover below. A rosebud? What a commotion of feelings did not the word create in my breast! For a time all my thoughts were centred on this idea, engrossed with the fancy of the charm which lay in that word. Alas! I saw in imagination the land where the nightingale sings in the rose-bush, while before me lay the frigid desert, where no plant can be cultivated, no rose bloom. What would I not at that moment have given for an hour's sojourn in:

"Das Land, wo die Citronen blühn,
Im dunkeln Laub die Gold-Orangen glühn,
Ein sanfter Wind vom blauen Himmel weht,
Die Myrthe still und hoch der Lorbeer steht;
Kennst du es wohl?
Dahin! dahin!
Möcht' ich mit dir, o mein Geliebter, ziehn."

The winter had now, as I have indicated, set in in earnest. During November the thermometer did not rise above freezing point, and very often we had, even in the middle of the day, 10° to 20° below zero. This was, of course, a respectable cold, which few would relish, but strange to say the cold up here is not, when one has suffered it a little, so terrible as it is pictured by the sun-basking children of the south. I have stood in such cold throughout the whole night, to daybreak, out in the open, taking observations every fifth minute, without

feeling it in the least. The principal reason of this is the remarkably quiet atmosphere which prevails here; sometimes not the faintest breath of wind is felt for days. But if it does blow with this low temperature it is hardly possible to remain out-of-doors.

It is of course obvious, that, in order to brave 50° of frost with impunity during an entire night, and almost without moving, one must be warmly clad. The previously-mentioned Lapp summer costume has now been exchanged for the winter one. It is in cut much the same as the other, but made throughout of fur. The cap is the same in form, but the crown is red, while the border is made of reindeer skin; in the crown lies a down-cushion. The principal piece of clothing is the Pæsk, to the uninitiated a terrible thing to get on and off, but wonderfully protecting against cold. It is, as I have mentioned, a long bag made of fur with the hair turned outwards, and no openings save holes for the head and arms. A broad leathern belt keeps it close to the waist. Beneath this Pæsk the Lapp wears another, of sheep-skin, but with the hair turned inwards. The legs are clothed in so-called "Bœllinger," also of fur. The feet are encased in "Skaller," similar to the Komager, but with fur outside and filled with grass. A couple of immense furry gloves, also filled with grass, complete the costume, and were it not for my spectacles, I might in my furry habit be taken for as true-blooded a Lapp as my worthy friend Jossa Pentha or Heika Tornensis.

In such a dress a man might face a hundred degrees of frost. The cold here does not, as I have said, feel so keen as one might fancy, but it had several drawbacks for my

work, the unpleasantness of which must have been experienced to be realised. When, for instance, every hair in one's moustache is transformed into spikes of ice projecting like the quills of a porcupine; when the faintest breath blurs the spectacles at the very moment when I am most anxiously watching the dial of the chronometer for an imminent transit observation; when every instrument is, as soon as exposed, covered with a layer of hoar-frost, which obliterates the figures, and the lens of the telescope has every minute to be cleared of a sheet of ice; when the fingers adhere to the metallic parts with a singeing pain as when touching red-hot iron, and when finally, the lamps go out, through the oil freezing, as you are in the middle of an important note—well, under such trying circumstances a man might be excused slipping a big d——.

During my sojourn in Koutokæino I received one or two inquiries from ladies "down south": "What do you burn there north?" As the question seems one of interest, I may tell that the fuel was birch-wood. Around the houses stacks of thin slabs of this wood have been stored, from which an excellent supply is obtained throughout the winter. It is cut from the copses on the river banks, and costs nothing but the transport.

Snow is generally associated with the term winter, more particularly in the Arctic regions, but in this respect we were just then not much troubled at Koutokæino. In November the fields were certainly white, but it was caused chiefly by the hoar-frost, and the cover of snow was very thin. We had up till then not a single great snow-storm, and during October the fall was only a few inches. The fall

of snow may be a matter of little consequence in some countries, but up here it is of the highest importance, as without it travelling—in the only manner known, viz., by reindeer and Pulk—becomes utterly impossible.

The little Norwegian colony at Koutokæino was not prepared for the absence of deep snow so long, so that by degrees we became in want of some exceedingly important articles of sustenance. There was first the brandy; the last of that went already in October, a most serious matter in this climate; other articles, such as oil and candles, soon followed suit, and a few days after the merchant announced that he was out of tobacco, sugar, and flour. The prospects of existence began to look cheerful.

In this stress the sheriff decided to dispatch, at all hazards, in spite of the almost bare ground, a "Raide," viz., a string of reindeer with Pulks, coupled together, to Bossekop to obtain fresh supplies, and after an absence of eleven days, most anxiously counted on our part, it returned with plenty of everything, and a "banquet" was given to celebrate the joyous event. They had, although reindeer are the fastest and most enduring trotters in the world, taken eleven days and nights to cover the eighty-five miles!

As to the reindeer, we did not see many of them in the winter at Koutokæino, although it is stated to be the richest district in Lapland in this respect. Now and then a Raide or a solitary Pulk passed by; that was all. The great herds of several hundreds, the so-called "Ren-byer" —reindeer camps—lie some ten miles from this place.

I saw, however, a single herd of about three hundred head, a sight I shall never forget.

It was in October, before the river was as yet frozen over, that they came from the north with Lapps and dogs to ford the river just by the church. They were only stragglers from a tremendous herd which had crossed lower down the river, and which the Lapps were now attempting to drive to their respective owners. Two Lapps, of whom one carried a large bell in his hand, went into a boat leading three animals by a rope to decoy the others to take the water. The river was full of ice-floes. The boat was punted into mid stream, and the three animals had to follow *nolens volens*. The bell began to ring, and the Lapps in the boat to roar "goof, goof, goof," while their companions on shore and all the dogs joined in the chorus, driving the flock down to the shore, where a sort of hedge had been put up to prevent them running along the bank. It was a splendid sight to watch the restless grey mass, as it was more and more pressed together, and observe the animation and anxiety which pervaded the whole flock; while the thousand antlers swaying to and fro high above their heads, looked like a close, leafless forest in a gale of wind.

The deer in the van dipped their hoofs into the water, reflecting whether they should follow their three comrades on the rope into the icy river, or remain on shore. They made up their minds to do the latter, and what one reindeer does all the others do, and as the Lapps and the dogs barred the road back and the hedge that down the river, they began to run round in a circle in which the whole flock soon joined, whirling round each other in the most extraordinary manner. The boat lies in mid-stream, the three reindeer stand shaking in the

cold water to the shoulders, the men in the boat ring the bell loudly, roaring "goof, goof" at the top of their voices, the dogs bark furiously, while the Lapps on shore jump and dance about to keep the herd together, shouting, if possible, higher than all. But there are too many deer for the two keepers. Alas!—one manages to slip between them, a second, and a third follows, and as the Lapps and the dogs take up the chase, the herd unrolls itself as quickly as a coil of rope, and is soon in full flight over the hills.

The boat must again go ashore, the herd again be driven together, and so the comedy begins anew.

The tied-up deer are again in the river, the bell sounds, "goof, go-of, go-o-of," shout the men, "whow, wh-o-wf," bark the dogs, and the chorus begins. But the animals refuse to take the water, the run round is resumed; then a deer finds an opening, and again the whole flock gallops wildly off.

A third time the boat must ashore, again the reindeer have to be driven together, and the play is acted over again with the same result. Yes, I believe, without exaggeration, that the attempt to get them into the water was repeated half-a-dozen times in vain; the animals, which are splendid swimmers, would not go into the ice-filled water. The last time one of them succeeded in breaking through the hedge, and now the whole herd rushed along the river-shore and up a hill, behind which they disappeared. The Lapps did not follow now; they were tired of the job, and sat down to consider what they had better do to collect the scattered animals.

I did not see more of either the Lapps or their unruly

herd, but I was told a few days after, that they had got across lower down at a spot where the ice bridged the river.

I shall never forget the characteristic and interesting sight on that occasion, which I enjoyed with all the sensation of novelty. I must smile when I think of an old, stout, and stumpy Lapp, looking shorter and more fat in the Pæsk than Nature had perhaps made him, who roared and danced about more madly than the rest to keep the herd together. When he became too hot he threw away first his stick, then the cap, and finished with flinging his Pæsk in anger after the runaway deer. As he jumped about, now here, now there, with his short arms and shorter legs, he certainly brought tears into my eyes with laughter.

But such is really the life of the Mountain Lapp: full of great troubles and exertions, of which the above episode gives but a faint idea. And still he is happy and content with his lot, his nomadic life, which he would not exchange for the most sinecure post in the world.

At this time another event happened which under Lapp "Events of the Year" would no doubt figure as "Terrible Fire at Koutokæino." One night I was awakened by the shout: "The school-house is on fire!" I hastened up; a fire in the Land of the Lapps was not a sight to be missed. The old school-house, to which I have previously referred as being in disuse, that is to say, being only occupied by the workmen who had come from Alten to erect the new building, was blazing most cheerfully. I found the entire population out of doors. The men were on the roof of the wooden building, while the

women were busy below carrying water from the well. It was a lovely cold and starlight northern night. The fire had originated under the roof, and the flames flared at first high into the air, but when the roof had been torn off the fire was extinguished in a quarter of an hour.

It was very fortunate that the weather was calm, as otherwise, not only the building, with a lot of timber and chips in it, would have been burnt down, but the sheriff's residence, lying next to it, would also have gone up in flames. There were no other appliances for extinguishing a fire in the place than buckets.

There is a moral to this tale which is not, I believe, generally known: I entered the Regions of Snow apprehensive of being *frozen* to death, and nearly became the victim of—*Fire.*

Such is the Land of the Lapps in the winter.

CHAPTER VI.

A VISIT TO A REINDEER CAMP.

In Darkness—Reindeer in Harness—Lapp Vehicles—Puzzles of Pulk-driving—We are off at last—My First Experience of a Pulk—Who Guides?—Our Appearance at our Destination—Welcome to the Tent of the Mountain Lapp—Limited Accommodation—Lapp Toilet—Domestic Utensil—Life in a Tent—Funny Dogs—Entering a Tent—Preparation for a Lapp Dinner—The Butcher in Furs—Hungry Dogs—Great Expectations—A Smile at Last—The Dinner—The Pipe—Bundling—A Strange Bedroom—Guarding the Herd—A Grand Scene—Lassoing Reindeer—Milking—A Lapp "At Home"—Reflections in a Tent—The Drive Home.

It is one of the first days in December. Our watches and a faint streak of light in the south tell us that it is near noon, as the sun is seen no more. It has set for good this year, and some six or seven weeks are to pass before we shall see it again.

In front of the sheriff's residence eight harnessed reindeer are waiting to take us to a reindeer camp about twenty miles off. Although always impatient, the splendid animals seem more so when on the point of travelling.

The travelling requisites are as simple as they can be.

First, two symmetrically-shaped bits of wood are laid above and below the neck of the deer, and fastened together. From the middle of these a band runs down

on each side to a semi-circled wooden block under the stomach, immediately behind the fore-legs. To this block the single trace, in Lappish called "Vuotta-raipe," is also attached, which is at the other end run through the fore-part of the Pulk. This trace is generally made of rein-deer skin.

From the side of the wooden block again a broad, or

REINDEER AND PULK.

narrow, belt runs over the back of the animal, while around the neck or the frontlet a rope or band is laid, from the lower point of which the rein runs. This is a single one and the end is wound several times round the right wrist of the driver, the thumb having previously been inserted in a hole in the end of the rein. This is the whole harness. It is loose and primitive, but doubtlessly best adapted to

reindeer driving. The belt and the neck-band are generally ornamented with yellow and red cloth, tassels, and other decorations, while a bell under the neck sounds lustily at every movement.

The sleigh—"Pulk"—seems from its construction to be better adapted to water than land travelling. Cut a low boat in halves, take the stem part and close it behind with a perpendicular sheet of wood, and you have a Pulk. It is about the length of a man, without any covering whatever, and completely empty, the driver squatting down in the bottom. As it is, moreover, provided with a keel, it will be pretty clear that it is about as easily managed as a boat on *terra firma*. The Pulk is built of birch-wood, but the keel, four to six inches wide and finishing in a point in front, is of fir. The wooden squares of which the sides of the Pulk—about ten inches in height—are made, are thickest in the middle and thinnest at the edges, which gives them a convex shape.

The true name of this sleigh is, however, "Kjærris," as the proper "Pulk" should be covered with a skin in front under which the legs are stuck. In these parts the two names are used for both, particularly as the Lapps do not care much about the Pulk, the cover being in the way when driving.

There is a third kind of sleigh called "Laakkek," which is similar in build to the two others, but with a lid to it. It is used as a kind of transportable store-house, in which are kept chattels and treasures for which there are no daily use.

As a fourth kind might also be mentioned the "Raide"

or Carriage-Pulk, which is used for the transport of goods. It is similar in construction to the ordinary Pulk.

It is not surprising that many should wonder why the Lapps adhere to this primitive, and, as it seems, awkward vehicle and accoutrements, which seem as if reindeer driving was an invention of yesterday; and nothing is more common than the novice driver making all sorts of suggestions for its improvement. But experience teaches everybody, that the Lapps, like most natives, know best what suits their requirements, and that the Pulk ought to remain as it is.

What is most annoying to the uninitiated is, that the Pulk does not, as the sleigh, travel on runners, but on a little keel, and capsizes, in consequence, at the slightest bump or want of balance on the part of the driver, and that it is drawn by a single trace, and not by shafts, from which it follows that the reindeer cannot hold it back down-hill, which often causes the traveller to come down rather more precipitately than he might wish, and, finally, that two reins are not used, whereby the animal might be driven better.

There is, however, very good reason why the Lapps prefer the single to the double system, and each one has advantages of its particular kind in reference to the nature of the road. A sleigh would, for instance, sink far deeper into the loose snow, and be knocked to pieces over rough ground, through forest and across mountain, where the road is obstructed with logs and stones, and the Pulk has often to shoot down a declivity of a couple of yards. The sleigh would capsize quicker than the Pulk strange as it may seem, as the latter only capsizes in the

hands of an inexperienced driver. The expert, however, has it completely in his power, and understands how to keep it straight with his body in places where a sleigh would be hopelessly upset.

Supposing, for instance, that a big stone lies in the road, hidden by loose snow, the reindeer will spring over it, while the Pulk following would show a strong tendency to capsize. Gently, however, the driver leans over to the opposite side, and the Pulk slides down by the side. The same argument may be advanced against the shafts. These would have to be very thick not to break, while they would prevent the Pulk from sliding down in such a case as mentioned, and, giving, in the innumerable curves of the road. Further, a sleigh would become entangled in the branches and underwood of a close forest. The Pulk, being wedge-shaped, can follow wherever the reindeer can get through, as there is nothing at the sides to offer any resistance. Finally, a pair of reins would be more inconvenient than useful, as the reindeer is not broken in and trained like a horse, and the expert driver knows how to manage it with one rein with the greatest ease.

Mais nous verrons! The eight fur-clad men, of whom I was one, were ready at last. It was to be my first drive in a Pulk. I imagined it would not be unlike driving with horses or bullocks. At the last moment somebody kindly gave me a few hints as to the placing of my body. I got inside, wound the reins around my wrist—and before I had even time to think or look ahead, the whole caravan shot forward, and off we went in the wildest and most chaotic manner, without order, right and left, the

Pulks swaying to and fro, and see-sawing, by way of variety, on their keels; and as the ground was but scantily covered with snow, the movements of the Pulk reminded me most vividly and realistically of a boat in a heavy sea. In one moment two or three Pulks jolt against each other with the most alarming cracking noise, and in the next they are yards apart. The sheriff's family, as I afterwards learnt, had assembled at the door to enjoy the fun of seeing me pitched out, but I disappointed them. I knew enough to understand that the secret of Pulk driving was to stick to the vehicle. I therefore let reindeer be reindeer, and did my best to accommodate myself to the pitchings of the Pulk by all the arts of balancing, and, although I am at a loss to understand how, I managed to keep my seat, and when the first surprise was past, I began to look around me.

We were speeding along in the most reckless manner and at a terrific rate. I never rode a horse in a steeple-chase, but from my slight knowledge of the sport I am prepared to wager, that the dangers are as nothing to this daring, devil-may-care sort of chase over fields and meadows, up-hill, down-hill, over boulders, logs and stream, without, as it seemed, aim or object. It seemed no question of guiding—the reindeer appears to select its own course and speed, without the slightest regard for either man or Pulk. It is, in fact, even for the most expert Lapp driver, only possible to make the reindeer follow a *general* course, but it chooses the road entirely for itself. The mathematical doctrine, that the straight line between two points is the shortest, the reindeer knows not, or utterly disregards. It seems to take the greatest delight

in making detours and zig-zag movements right and left, and to make the journey twice as long as necessary.

A reindeer in harness seldom walks; either it trots or gallops, as hard as it can, with the tongue out of the mouth and panting like a dog out of breath. From time to time it takes a bite of the snow to quench its thirst. It is quite a comical sight to see its short hopping gallop, as both hind and fore-legs come down almost simultaneously. With the broad hoofs of the hind-legs the snow is kicked behind in such a manner that the driver seems in a drifting snow-storm. This is accompanied by a peculiar cracking noise in the houghs, when galloping, which may be compared to the production of a series of electric sparks, or the crackling of salt thrown on a fire. This is caused by the motion of certain muscles in the foot.

After a run of half an hour the Pulks in the van stopped to wait for the stragglers. All deer are not equally quick, and it appeared that I had obtained the laziest of them all. For this, I was, however, very grateful. When a reindeer stops after such a run it pants worse than ever, sometimes even so heavily that fears might be entertained of its sudden collapse, but this lasts only for a moment. The animal soon recovers.

I was, I am proud to say, not long in learning the mode of starting, viz., to cast the rein with a jerk over the shoulder of the reindeer—to the right side—at the very moment the driver jumps into the Pulk; but the latter action is not as easily accomplished as may be imagined, as on the slightest indication of the intention of the driver, the reindeer starts off at a wild gallop. When driving, the animal is guided simply by throwing

down a slope in the greatest confusion, the Pulk either coming in front of the reindeer or the deer into the Pulk. To me the drive on the river or over large lakes was undoubtedly most attractive, where we travelled with the speed of the fastest train, over undulating white flats on which the virgin snow had never before been trodden by man or beast.

After about two hours' driving, which, although I expected every moment that one of us would break at least a leg or an arm, was the most interesting and exciting journey I ever undertook, we arrived at the place where the Lapp families had settled with their herd. A column of smoke and the barking of a couple of dogs welcomed us to the abode of the Lapp nomads.

How we did look when we got out! We were all completely transformed into snow-men. The Pæsk and cap were white with snow, the hair and eyebrows woven with threads and crystals of snow and hoar-frost and the beard a single lump of ice.

The "dwelling" of the Mountain Lapp has not much in common with what civilised beings associate with this term. There is no question of building, rooms, or roof. The Mountain Lapp lives, summer and winter, in snow and sunshine, in his tent. A simple structure of a few long logs raised on end, over these a cover of "Vadmel," a kind of coarse woollen stuff, or a rough canvas: this is home.

The tent is conical in shape, and as the circle is broken the diameter varies from 12 to 16 feet. The height is 8 to 10 feet. At the top is an opening which is window, chimney and ventilator all in one, and immediately below it is

the hearth—always alight—on which the food is cooked and by which the tent is warmed. On the other side of the tent is a small aperture, which may be closed with a door made of Vadmel and cross sticks fixed in the pointed upper end.

The narrow apartment, in which one can hardly stand erect, is the dining, "drawing" and bedroom, kitchen and

LAPP TENT.

larder, &c., of the whole family. Of furniture there is none. The ground, covered with birch-boughs, is chair, table, cupboard, floor, and bed. In the day the occupants squat tailor-fashion, around the fire, eating, drinking, or working, and during the night they huddle around it. The dress forms the bedclothes.

Undressing at night or toilet in the morning are things unknown to the Mountain Lapp.

The domestic utensils are limited to some kettles and pots, wooden saucers and scoops, a few spoons of wood or horn, sometimes silver, and a couple of deal boxes for keeping odds and ends in. On rafters, supporting the tent, harness, reins, clothes, and meat are hung.

Near the tent a structure is raised of birch boughs joined at the top, where skin, clothes, &c., not immediately required, are stored. Any other things the Lapp may possess are treasured in the previously described Pulks. In front of the tent stands a heavy block on which birch-wood for fuel is hewn.

It is obvious that life in such a tent is not very refined or well regulated. There are no fixed meals, caused chiefly by the circumstance that the members of the family have each to take their turn in guarding the reindeer. A large kettle hangs always over the fire, and when a Lapp wants to eat he dives *sans façon* with his hand into the pot, fetches out a choice morsel of meat, which he devours by the aid of the long sheath knife carried by his side, the fingers serving as forks. In fact, a visitor to the Land of the Lapps must not be too fastidious or dainty: he must not take objection to a Lapp lady attending to the wants of her newly-born babe in the middle of a meal, or that the Lapp has a strong predilection for "licking." His tongue reminds one of a dog's.

During the winter reindeer meat and milk—the latter either frozen or in the form of cheese—and melted snow constitute the food and drink of the Lapp, in addition to which he will, when obtainable, consume a large quantity

of coffee. Anyone sharing in a Lapp's meal must not be disgusted if he finds a certain amount of reindeer hair in the food; these are inseparable from each other wherever they mix, as the latter stick to every object, kettles, spoons, forks, knives and hands. It is almost impossible to get rid of them, as by the slightest rubbing they become very electrical and adhere still more. It is a true saying here, that "He who has not eaten a pound of reindeer hair in his lifetime cannot have been well married."

When a tent is occupied by half-a-dozen people, there is indeed not much room to spare, not even enough to "swing a cat in," and this is filled with smoke. The atmosphere is, therefore, not what a sanitary inspector would record as "fairly pure," particularly as the tent is shared by three to four dogs of a comical appearance, which, when wagging their tails, wriggle the whole hind-part in the most amusing manner. These animals, small and with pointed nose—very like a Pomeranian in breed are always on the alert, and always hungry. They are the trusty guardians of the reindeer, and the Lapp's only domestic animal, and, as such, they have the right of disporting themselves in his tent in common with the band of dirty little brats. The dogs even "sit at table" when food is consumed by their master, and watch with their little blinking eyes every morsel of food as it passes from hand to mouth with intense attention. In the night they crawl about the tent, selecting the warmest of the company for a couch.

The height and size of the tent were so considerable that, had it not been for all the things in the way, I

would have been able to sit comfortably on a box, and even move erect a pace or two in the middle. But what prevented this was, in the first instance, the cloud of smoke which always fills the upper part of the tent, and in order to escape which it is necessary to lie down; secondly, the hearth, which occupies the centre; and, finally, the people and chattels which had possession of every available space. It is almost impossible to pass in or out of the tent, when the family are there, without being half suffocated with heat and smoke. The tiny door is hardly raised, and the back bent low to creep in, before the dogs rush at the intruder barking furiously and showing their glistening teeth, while fire and smoke blind so, that several seconds elapse before the eye is able to make out the largest object. To the irritating barking of the dogs is also added the squealing of babies, accompanied by coaxings and slaps to bring them to silence. During all this confusion the visitor stands at the entrance with his back crooked until a spot on the floor is ready for his reception; he then cautiously advances to the assigned place on the edge of the roaring hearth, in extreme danger of landing on his face therein or burying his hands in the seething kettle. Arrived at his seat everybody scrambles to make more room by drawing in their legs, while the children are "put aside."

When I had overcome these difficulties and conversed a little with the Lapps, a large piece of reindeer meat, which had occupied the place of honour before the fire, was so far thawed that it could be cut up. The Lapp who was to perform this feat, rose on his knees, while

everybody, dogs and all, drew their legs in to make room for the butcher in furs. He grasps the joint with one hand, with the other lifts an axe high above his head, and as slowly and gravely as if he were a public executioner he lets it fall on the meat.

If possible the gravity of the dogs exceeds that of the Lapp. They have seated themselves as near him as they may be permitted, with such a serious expression on their faces that it might really "make a cat laugh." Gradually they move nearer and nearer to him, licking their mouths, and greedily following with their eyes every piece of meat as it descends into the kettle. From time to time a warning halloo! is ejaculated when one of them is on the point of abstracting a piece of meat which the axe brings within its reach. When the butcher had to resort to a second stroke to separate the piece he was greatly jeered at by his companions, which however did not move him in the least. It was when he threw the last piece into the pot that a smile of satisfaction first overspread his face. We now resumed our former outstretched position.

Soon after the primitive meal had been consumed we began to prepare for sleep, and when room enough had been made for me to struggle into the sleeping-Pæsk in which my host assisted me, the Lapps laid down, bundling with each other, all stretching into a circle around the flaming log-fire. In a few minutes later all talk has subsided, while the fire burns lower and lower. All is silence; only here and there a faint breath or sigh escapes the Sons of the Mountain. I lay for a long time gazing at the wonderful group around me, over which

the glowing embers cast a ruddy tint, and from this my eye wandered aloft, where I could see the stars blinking in the deep-blue sky and an occasional aurora flit over the heavens, when I also sank into sleep.

It is only rarely that the entire family is at once collected in the tent, as the reindeer herd always requires their attention, night as well as day. Men, women, girls and boys, all share alike in this labour, being relieved twice a day. Each one brings his own dogs with him, which only obey his commands, while those relieved take back their hungry ones. Often, therefore, eight to ten dogs walk over the sleepers in the night to find a snug corner. And they certainly require rest, considering that they are in constant activity all the day guarding the restless flock. On them depends the safety and well-being of the herd, and by them alone is the flock gathered and moved from one place to another; they also protect the deer from the wolf, the terrible plague of the Lapp. When the wolf is scented the reindeer run frightened away over the wastes, but the dogs soon bring them back, driving them together so closely that the wolf does not dare to attack the flock.

According to our desire, the whole herd of deer were driven down to the tents. It was a very imposing sight indeed to see the flock, numbering over 1200, come galloping down the snowy hills, their bells tingling pleasantly, and followed by the barking dogs and the shouting Lapps. What life, what stir and restlessness in the immense grey mass! The reindeer is never quiet, excepting when it lies down; it constantly moves the legs, or the body with the grandly crested head

and the sagacious eyes. Here a couple of bulls begin to fight, their horns meeting with a loud crash; so serious are these combats that the horns often get entangled, and if no assistance comes, the animals may starve to death. There a reindeer attempts to get away from the rest, but it does not get far: the dogs are soon on its track, driving it back apparently in the highest anger and passion, encouraged by the shouts of the Lapps. In a few moments the would-be-deserter disappears terrified in the flock. From time to time some of them stop, digging large holes in the snow with their fore-legs to get at the moss underneath.

There is great variety in the shape of the horns of the reindeer, apart from the circumstance that those of the cows are, as a rule, smaller than those of the bulls. Thus a few have none, others have only a single short antler, while others are ornamented with two—sometimes three—large magnificent horns with innumerable branches and points of various shape.

While the herd stayed in the vicinity of the tents the opportunity was taken to milk some of them; but the operation was not as simple as the milking of cows. The reindeer is never so tame that anyone can walk up and stroke it; when it is wanted for being milked, as well as for driving, it has to be lassoed like the wild horse of the Pampas. The lasso used by the Lapp is from 30 to 50 feet long, and is held coiled up in one hand. It has a loop at the other end. This is the so-called "Suoppa," which the Mountain Lapp always carries round his shoulders when travelling, and in the use of which Lapp children are always practising on the dogs or their companions.

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A REINDEER CAMP.

When the Lapp has "spotted" the animal he desires, and his keen eye is not long in searching, he throws the lasso from a distance of 30 to 40 feet, and the rope shooting over the heads of the others, the loop unerringly encircles the horns of the deer wanted. As soon as the animal feels the cord round its horns it starts off, whereby the loop becomes still more tight, and a severe struggle ensues between the two, which results in victory for the Lapp, who by degrees comes near enough to the animal to grasp its horns. While holding it in this manner the women milk the deer.

The milk is run into peculiarly-shaped, round, wooden saucers with a handle; but the quantity obtained from one animal is very small, two or three giving only half a pint.

It was an exceedingly interesting and original episode in the life of the Mountain Lapp we thus witnessed; it was doubly strange and attractive to a Southerner.

We were later on invited into the tent of an old Lapp to take coffee, which we asked to have without salt, as the Lapps are in the habit of throwing a quantity of this article into their coffee, believing that it purifies the fluid and improves the flavour. *De gustibus non est disputandum.*

A large lump of a yellow-whitish, lard-like, substance was brought out, which I at first believed was an imitation of butter, but which turned out to be frozen reindeer milk. A piece being cut off, it was put into a cup, the only piece of crockery in their possession, and which had been washed for the solemn occasion—to serve as cream. The Lapp is not stingy as regards the coffee,

and as he uses no substitutes, such as chicory, his beverage is very good and strong. They are also very extravagant in the consumption of sugar, loaf-sugar being generally used, but I had on this occasion reason to be thankful I never am in the habit of taking this luxury, as the little bits offered me were very dirty and discoloured through handling. But, as I have said before, he who desires to visit the Lapps, must not be of an æsthetic turn of mind; he has to strip off the European, and descend to the level of culture of the Asiatic; if not, he will never know them.

The only coffee cup circulated among us guests, whilst the occupants of the tent drunk out of the lid of the kettle, an empty sardine box, and a tin of Cross and Blackwell's "Ox-tail Soup," trifles which by the vicissitudes of life had found their way to the Land of the Lapps.

Shortly after the smoke from a dozen pipes mingled with that from the fire, and we sat there, we Europeans in our furry habit, snugly and contentedly enough, in the dark, narrow space, between Lapp men and women children and dogs. When I looked at the fantastic group around me and at my own dress, all lit up by the flickering fire, I had my doubts as to my own identity and whether I really was in old Europe, and that in the Nineteenth Century. How different this was to what I had been accustomed to!—slowly the homes of my friends in the South rose before my mind, where comfort and refinement reign.

And still the Son of the Mountain, the last nomad of North Europe, is, perhaps, happier in his narrow little

world than the sybarite in gilded saloons surrounded by every luxury the most advanced civilisation can procure. He knows not the anxieties and troubles which high culture forces on man, but neither does he know the pleasures, the enjoyments of a superficial existence in the centres of civilisation. Maybe he is the happiest of us all?

Evening had now so far advanced as to compel us to think of returning. When the reindeer were harnessed we were again off on a mad scamper over the snowy wilderness. If possible the drive home was more haphazard, more furious, than the outward one, as darkness rapidly increased. But we arrived home safe and sound, and I can only add, that the excursion was one of the most interesting and enjoyable I ever undertook.

CHAPTER VII.

ABOUT THE LAPPS.

CONFUSING DENOMINATIONS—THE AREA OF LAPLAND—DIVISIONS OF THE RACE—THE WANDERINGS OF THE LAPPS—PRECARIOUS EXISTENCE—WRETCHED LIVING—THE STAY ON THE ARCTIC COAST—REINDEER SWIMMING—THE KVÆNS—THEIR DESCENT—A LAPP'S TRAVELLING OUTFIT—SPLENDID WALKERS—THE "SKI"—TREMENDOUS SPEED—RIVER COMMUNICATION—SHOOTING THE RAPIDS—MARVELLOUS BOATMEN—DOMESTIC RELATIONSHIP—LAPP DRESS—FEMALE CLOTHING—HOW THE BABIES ARE CARRIED—THEIR HEIRLOOMS—THE PROTECTION OF THE "KOMSE"—THE GAMES OF LAPP CHILDREN—INGRATITUDE TOWARDS PARENTS—SERVANTS—PHYSICAL CHARACTERISTICS—WRESTLING—"CLEANLINESS IS NEXT TO GODLINESS"—*PEDICULUS*—WELCOME AT A TENT—KEEN HUMOURISTS—IMMORALITY—LOVE OF SILVER—BANKING—DRINK—"NEVER BE IN A HURRY"—GOOD-TEMPERED PEOPLE—TRUE CHILDREN OF NATURE.

THE race which inhabits the corner of the world to which I have brought the reader is called by the Norwegians "Finns" and by the Swedes "Lapps." From the latter denomination of the race, that used in most other European languages is derived.

The people themselves do not recognise either of these names, but claim the name of "Sabme" or "Sabmeladsjak," in which words may be traced those of "Suomi" (Finland) and "Suömalaiset" (Fin) and

that of "Samoyed," two races closely allied to the Lappish.

The Lapps inhabit a considerable area of territory, viz., nearly the whole of Europe north of the 66th degree of

MOUNTAIN LAPPS FROM KOUTOKEINO.

latitude, in some parts of Sweden and Norway even descending to the 63rd degree. This territory includes the parts of Russia proper, Finland, Sweden and Norway which jut into the Arctic Ocean, covering about 7000

geographical square miles, the population being estimated at about 30,000 souls.

In Norway the greatest number of Lapps are found in the northern parts of the provinces of Nordland, Tromsö, and Finmarken, but small settlements may also be met with in the central "Amts" of Trondhjem and Hedemarken. The total number in that country is 17,000 to 18,000 individuals.

The Norwegian Lapps are divided into three groups, viz., the nomadic Lapps, called "Fjældlapper," i.e., Mountain Lapps; the Settled Lapps, living on the sea-shores, called "Sölapper," i.e., Sea Lapps, and those living on the banks of rivers, who are called "Elvelapper," i.e., River Lapps.

The life of the Mountain Lapp is not very regulated, being partly guided by the seasons, partly by circumstances of various kinds. He sleeps, eats and drinks when he can; meat is his most cherished, and in the winter, almost only food. Between meals he sometimes consumes a little frozen reindeer milk mixed with berries, cheese or rye-meal cakes baked over the fire. Sometimes he is poor, sometimes rich, and if his herd decreases he is forced into service or to take to the sea for his living.

The wealthier Lapp eats more, drinks more, and keeps more servants than the poorer, his wife and daughters wear more silver bangles and buckles than those of the other—that is the only difference between the two.

Each family has generally certain districts through which they wander every year. Thus, the Lapps from

Koutokæino and Karasjok, parishes adjoining each other, are in the habit at Christmas time of sojourning in the neighbourhood of the churches, and afterwards move southwards, and up to the year 1852—when a Russian Law of Prohibition was promulgated—even into Russia, where the high snow in the close forests at that time of the year afforded the reindeer very good protection from the wolves. Towards the spring they return by the same route to the north, arriving in the earliest part of the

LAPP FAMILY AND TENT FROM KOUTOKÆINO.

summer on the sea-shore or the hills bordering on the sea. In the autumn they again retrace their steps to Koutokæino and Karasjok. Professor Keilhau states, that some Lapps whom he visited moved in this manner from Faskojok—on the Lake Enare—to the island

of Magerö, viz., a distance of some four hundred miles.

The stay of the Lapp in a certain place depends on a variety of circumstances, as, for instance, the richness of the reindeer moss or presence of wolves; but it is seldom that he remains quiet in the same spot for more than three or four days. Then he can rest no longer, but moves the tent, at all events a couple of miles away. The chattels are gathered together and transported—in the winter easily enough in Pulks, but in the summer with far greater difficulty, on the back of the reindeer—to the next camping place.

The Mountain Lapps are the parent tribe of the two other varieties of the same race. To the mountain, the desert, to the life in the free open air the very existence of the nomad Lapps is closely allied; with them are his joys and sorrows, all his recollections interwoven, in fact, his entire being both internally and externally. Here, only here is his true home. The blue canopy of heaven and the mountain air he inhales from his birth becomes a necessity to his nature as he grows up. The Lapp passes almost his entire life in the open air, and his tent does not even protect him against the autumn rain, the winter snow, or the spring storms. Sometimes the rain floods his tent or the snow envelops it, and sometimes the wind levels it with the ground. But still the snowy desert is his chosen home, and it is only here that he can be studied and judged with justice. The roaming life of the nomad of North Europe over the free mountains and the snowy wastes, where he may pitch his tent and graze his reindeer where he lists free from

the trammels of civilisation, in constant fight with the elements, calls to life and fosters a sense of independence and strength which undoubtedly has the effect of making him contented. The deep blue sky with myriads of stars and the flaming, mystic aurora, which are never hidden to his eye, have made the mind of the Lapp susceptible to impressions and emotions. In summer as in winter, in spring and in fall, the Mountain Lapp roams over the immense high plateau with his reindeer herd, guarding it day and night. With this he is brought up, it forms his sole heirloom. His father was a nomad, as were also his ancestors before him. In order to maintain and increase his herd the Lapp has to toil and suffer like the peasant on his inherited patch of soil.

During the halcyon days of summer the Lapp is seen wandering on the shores of the Arctic Ocean, but he is a visitor only; there is not his home, there he cannot rest, there he does not inhale the pure, invigorating mountain air. Life on the sea-shore among the dead and drying fish is wretched compared to that among the spirited reindeer in the wild mountains.

The reason why the Mountain Lapps leave the mountains in the summer for the sea-shore is, that the reindeer at that season wander thither, where it is not so hot and where the gnats are less numerous, and where they may bathe in the fresh sea water. There is, however, another reason, of far greater importance, which regulates the wanderings of the reindeer to the coast, viz., that the stay there spares the moss fields in the mountains during this period, making them more luxuriant for the winter grazing, and that the Lapps, having hunted and

slaughtered during the winter, have certain articles to dispose of at the season when the traders visit the coast. It would thus seem to be the wisdom and foresight of the Lapps which cause these movements, and not the migratory instinct of the reindeer, as is generally supposed.

In the summer the shores of the Arctic Ocean are enlivened by thousands of reindeer, which in large herds graze on the slopes or swim about with their magnificent spreading horns towering above the sea, from a distance having the appearance of a floating forest. For the sojourn by the coast, lasting about three months, most of the Lapps bring with them a small light summer-tent; and many of them do a little fishing during this period, as the reindeer move restlessly from one shore to another. Even during this short time the Lapp is unable to remain in one spot.

The Mountain Lapps, the back-bone of the race, live solely and entirely on the reindeer. Their skins make his clothes, their flesh and milk constitute his food and drink, and from them he obtains all his other little requisites of existence. If the wolf or accidents should destroy such a portion of his herd that it becomes unable to maintain him and his family, he either joins company with others equally unfortunate, to guard their joint herds, and in turn wanders to the sea to fish or remains with the herds, or he is compelled to sell the remnant and remove to the coast or the river, where, purchasing the necessary gear for fishing, he settles as a Sea Lapp.

The number of Mountain Lapps in Norway is only about 1500, thus forming a very small portion of all the Lapps in that country.

The Sea Lapps, of whom I will later on give a description, the most numerous by far of the race in Norway, live to a great extent like the Norwegians on the shores of Finmarken. They live on, or very near the coast, in earthen hovels—"Gammer"—or in wooden huts. Their food is generally boiled fish and a kind of soup

FOUR OF MY LAPP FRIENDS.

of barley-flour, into which sometimes salt or dried meat and lard is thrown. Fresh meat is seldom to be had. To this fare may be added sheep's or goat's cheese. The meals and habits of this group of Lapps are more regular than those of his Mountain brother; he is, in fact, a fisherman, and lives generally like the poorer of this class of people.

The River Lapps form a kind of connecting link between the Mountain and the Sea Lapps; they have fixed dwellings, but also keep reindeer. Most of this group are found in the neighbourhood of Koutokæino and Karasjok, and in certain districts of East Finmarken. They seldom live singly by the river shores, but form small settlements.

These Lapps descend to a great extent, from Finns, or, as the Norwegians call them, "Kvæner," who, towards the end of the 17th century, immigrated from Finland. They differ therefore, ethnologically, from the true Lapps, but this difference time has entirely effaced, and there is now no other between them than that which opposite habits of living have created. Even their original tongue has been thrown overboard, and, although they may understand the old Finnish dialect, in common with most Mountain Lapps, from constant intercourse between the races, Lappish only is spoken in their families.

The River Lapp generally, as I have stated, owns some reindeer, but he cannot be said to live on them. His chief means of sustenance are a little cattle raising, fishing in the lakes and rivers, and hunting the ptarmigan on the mountain. The fields yield a good deal of hay, but it is not very nourishing on account of the watery soil, which nothing is done to drain. With the hay obtained a few cows and sheep are reared along with the reindeer, and, in Karasjok, two draught-oxen, I believe the only two in the whole of Scandinavian Lapland. In the Koutokæino district there are no cattle, but the Lapps living here have each a few reindeer, which are taken care of by a less fortunate Mountain Lapp, who

undertakes for a certain payment to keep his herd near the huts during the winter, so that the reindeer

YOUNG LAPP FROM KOUTOKÆINO.

may easily be fetched for carting fuel, hay, &c. Some of the wealthier Lapps thus keep a goodly number of deer for driving, viz., from twenty to thirty oxen and

an equal number of cows, whereby they have sufficient meat for their households, and need not purchase young deer as the old ones become useless. In addition, the posting and goods transport to and from Koutokæino during the winter, as well as the carrying of the mails, yield a considerable revenue.

The trades of the River Lapps being a mixture of

A GROUP OF LAPP "BEAUTIES."

those of the Sea and the Mountain Lapps, their domestic economy may be said to have also absorbed the advantages of both, without their suffering the hardships and privations of either. They may enjoy a quiet life, and possess all the intellectual, dietary, and economical advantages of a well-regulated household; and they do not suffer the constant and severe battle with a rigid Nature to which the Mountain Lapps are subjected. And, while

the food of the Sea Lapp is almost wholly fish and rye-soup, and that of the Mountain Lapp, reindeer meat, the River Lapp may revel in meat, fish, game, vegetables, and milk.

The Mountain Lapp alone has thus preserved the pure, genuine characteristics of the nomad; the others are degenerated Lapps, and the River Lapp is, so to speak, the civilised native.

In the summer the Lapp generally moves about on foot. He is a good walker, covering with ease some thirty to forty miles in a day. On his wanderings he always carries a birch pole, six to eight feet long, which he uses for jumping in the mountains, or for crossing streams. This he generally cuts from the underwood, as he starts off. His outfit is of the simplest. His every-day garb, a reindeer cheese and a bit of dried meat in his pocket, pipe, tobacco, and matches, and his shoe-laces tied firmly—a most important matter for walking with ease and keeping dry—and he is ready to proceed to the world's end. He carries no sleeping requisites with him, as on this score he is not very particular; if he cannot reach one of the dwellings of his race he creeps in the shelter of a stone or a tree, and, if the weather is cold, lights a bonfire by his side, and goes to sleep.

In the winter, on the other hand, when snow lies high over every object, he runs on "Ski." These are two ribs of birch or fir, six feet long, four to five inches broad, and about half an inch thick. In the middle, on the upper side, is a hollowed, smooth spot for the foot, above which there is a strap, the space allowing the insertion of the point of the shoe. On the other side a groove runs along the entire centre.

The Ski are pointed and slightly curved at one end, and the edges rounded. On these the Lapp either runs or shoots himself along by means of one or two birch staves. Sometimes a small cylinder made of wood and sinews is fixed at the lower end, to prevent the staff sinking deep into the snow. Down-hill the Lapp generally rides on one of them, which acts as a drag and enables him to steer.

A "SKI" RUNNER.

The Ski are to the Lapps of the greatest importance during the winter, as without them it would be impossible to get over the deep snow. From the above description it will be understood that the Ski are very different to the snow-shoes used by the Indians, which consist of an oval wooden ring with a kind of net above it, in the centre of which the foot is placed; the latter

and attains great skill in this sport. He runs with the greatest ease up or down-hill, jumps the steepest in-

JOHANNES PERSEN PENTIIA (45).

clines, and speeds across lakes and marshes, through forest and field; hunts the wolf and the bear, or follows

the runaway deer, and undertakes extremely long journeys, following his herd or visiting distant parts.

BIRRET MIKKELSDATTER HÆTTA (20).

In the summer the boat is an important means of communication, enabling the Lapp to journey long

distances over the lakes and winding rivers with which Lapland is covered. I have already described the kind of boat most used. It is almost exclusively used for rowing and punting, and seldom sailed. The boats used by the Sea Lapps are, however, similar to those in use among the Norwegian fishermen.

The journey up-river in these boats is performed by two Lapps, one standing in the bow, the other in the stern, each with a pole, some ten feet in length, which they place rather under than by the side of the canoe, and thus punt it along. With great skill and practice the men shoot the boat up-stream with rapid and firm strokes, leaning far out of the boat, and resting their knees against the gunwale. When the pole is brought out of the water it is thrown forward with a swinging movement, the boat being kept near the shore. If several boats are in company, they are kept in the wake of each other; but not until the ardour of the boatmen has subsided somewhat, as at first there is a great deal of racing as to who shall be in the van. Such a struggle is accompanied by a great deal of merriment, and a company of boats shooting up-stream, in bright sunshine, is a pleasant and animated sight, particularly for those seated in the last boat with the sun at their back, the crystal drops shaken from the poles, as they are thrown backwards and forwards, reflecting the rays of the sun with all the colours of the rainbow.

Sometimes the lifting of the pole makes the man lose his balance, and such immersion causes great laughter among the company. Thus in clay, the pole is liable to stick, and the punter has no other choice but

to let it go, or cling to it when the boat shoots forward.

Down stream the task is very different. When approaching the roaring and whirling rapids the lively chat of the Lapps suddenly ceases, the eye is fixed on the water. "Pull hard!" calls out the captain, who sits steering with an oar aft, and the boat shoots swiftly down into the foaming rapid. Often it looks as if the roaring waters would swallow up the frail craft, as it is within an inch or two of a rock, so narrow is the channel to be shot. But it is so nicely calculated that beyond a little spray no discomfort is experienced. It is necessary that the boat, when shooting a rapid, shall have a speed of its own beyond that given by the current, in order to obey the oar, and it is for this reason that it is pulled hard into the fall. The waves in the foaming eddy rush in all directions and are very dangerous, as their fall or run cannot be calculated. It is almost impossible to pass close to the shore on account of the boulders.

To steer well it is necessary to calculate the speed of the canoe to a nicety, in order not to turn round a rock too quickly. It looks, therefore, like certain death as the boat is steered right on the stone, but in the next second a slight twist is made, and she shoots past within reach of hand.

Besides great skill, a close local knowledge of the river is necessary to navigate the boats, as the helmsman must know every stone in it, whether it is possible to pass over it or not, and this knowledge has to be acquired afresh every year, as the ice continually changes the position of the stones to a great extent;

thus, where the river was shallow one year it may be deep the next, and *vice versâ.* Like an eel the long elastic canoe glides through the foaming waves, obeying the slightest twist of the steersman's oar, under the silence of all on board, but as soon as she shoots from the rapid into the calm stream below a shout is raised, and the merriment breaks out afresh. The oars are taken in, and the boat is left to drift with the stream, in order to give the men a few minutes' rest after the fatigue and excitement of the last few minutes. But often the rest is of short duration, as several waterfalls follow each other, as a rule, in rapid succession. The fragile build of the Lapp canoe makes it vibrate before each wave, but its elasticity prevents it from being crushed in the foaming rush of the water, as would be the case with a stiffer craft.

Among the Mountain Lapps the work out of doors is chiefly performed by the men, and the domestic labour by the women; but if there be no grown-up sons, or the wealth, viz., the reindeer herd, be not so great as to permit many servants being kept, the women will share in the out-door work, particularly in guarding the herd, and they generally milk the deer, the men catching and holding them.

One remarkable feature in the domestic relation of the Mountain Lapps is, however, that the women never, except in cases of absolute necessity, cook the food; this is always done by the men. The men carry the fuel and water, light the fire, put the kettle on, boil the water, prepare the food, and distribute it, when cooked, without any assistance from their partners.

In addition to this task, the man, when at home and there is little to do, is occupied in making and repairing

ASLAK JOHNSEN BALS (35).

his implements. Sometimes also a Lapp may be skilled in carving, in horn and wood, such things as pipes,

buckles, spoons, &c., which articles are often tastefully ornamented. Some are also clever at making ropes, reins, &c., from the tough roots of the spruce and fir.

The woman, on the other hand, makes the clothes of the family, of which the Settled Lapps weave some themselves; but the women of the Mountain Lapps weave only the ribands with which the shoes are laced, and their belts. Clothes of Vadmel, and sometimes broadcloth, they sew with ordinary thread, but those of skin and their shoes, with the sinews of the reindeer.

I will add some details, beyond those already given, of the dress.

The coat is mostly made of Vadmel, the cut being like that of a shirt, with a high collar. The Sea Lapps generally use uncoloured stuff; but the others, and particularly for festive occasions, prefer blue, green, or brown, and even bright red. Sometimes they will wear black velvet coats, but even those will be ornamented with red or yellow borders of cloth at the wrists and on the back. Under this coat, nearest to the body, one of a similar kind is worn, but not so well finished; the Lapps never wear linen. In hot weather only one coat is worn, but in cold an extra one of sheep-skin is generally put on close to the body. The whole is girdled by a leather belt, fastened so far down that the coat may be drawn up and fall outside the belt with large folds at the back. In the belt-strap hangs the large knife, which the Lapp always carries, and which he uses both as knife and axe. The breeches are made of white Vadmel, are very tight, and reach only to the ankle, where they are tied into the Komager. Outside the breeches, gaiters—Bællinger—of

fine-tanned skin, reaching from the knee to the ankle, are often worn.

Socks are never worn, but the shoes are, as mentioned, filled with a kind of grass, which is collected in the summer and made soft by beating. The grass is taken out every night and dried, or exchanged for fresh.

In addition to the gloves referred to, highly-coloured mittens are used, particularly in mild weather and when the Lapp is driving; the former afford great protection against the bumpings and joltings of the vehicle.

The under-garments in the winter only differ from those worn in the summer by being of fur instead of Vadmel, or wash-leather. The cap in use in Koutokæino and adjacent parts I have already described, but caps of a different kind are worn in other districts. Underneath the Pæsk, or coat, a satchel is carried round the neck, on the breast, in which nicknacks, money, &c., are kept. No pocket is worn, larger articles being put into the bosom of the capacious coat.

The coat of the women is similar to that of the men with the exception of having no collar. In its place a little shawl is spread over the shoulders--on festive occasions two or three, the uppermost one being of silk. In the woven belt, ornamented with silver, scissors, needle, thread, and keys are carried along with the customary knife. The cap worn by the Koutokæino women fits close to the head. It cannot be said to be becoming, but it is generally carefully made and prettily ornamented. It is made of blue or red cloth, with lace in front and covered with flower-patterned cotton stuff and silk ribbons.

wooden disk at the upper end, similar to that on certain cradles, to which a shawl is attached which may be spread over the entire Komse. For the amusement of the child a few coloured ribbons are drawn from one end to the other and strung with glass beads, silver buttons, &c. When the child is packed in the Komse the leather coverlet, below which the legs lie, is laced down. A leather strap runs also between both ends of the Komse, which the mother casts over her shoulder in carrying it when walking, and in this the baby is hung up in the tent or on the branch of a tree when the mother has work to perform. The youngest babies are always carried by their mothers on journeys to fairs, church, &c., as there is no kind neighbour to whom they can be entrusted.

This mode of nursing babies is undoubtedly the safest and the most consistent with the Lapp manner of living. When the baby is snugly packed in the Komse, it is not only easier to handle, but it may also be left to itself in perfect safety for a time. Mothers may thus be seen to stick the Komse on end in the snow, while calling at some place or another.

I was told a story in Koutokæino of a reindeer bolting with a child in a Komse in the Pulk. The Pulk capsized at the outset and was dragged over very rough ground. It was naturally assumed that the child's brains were dashed out, but how great was the surprise, when the reindeer being captured after half an hour's chase on Ski, the child was found—asleep. The reindeer was found standing a couple of miles off, the rein having caught in a shrub; the Pulk was turned over; inside it the baby lay

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WOMAN WITH BABY IN "KOMSE."

sleeping peacefully. The disk on the Komse and the coverlet had parried the blows, and even kept the snow out.

When a child is born it is given a reindeer, and another on getting its first tooth. The offspring of these animals belong to the child, and if the deer be prolific, and no accident happens to the calves, the child may have a fair nucleus of wealth on attaining its majority. Such animals are not included in wills.

The games and amusements of Lapp children are naturally very different to those of other races, and consist chiefly in making lassoes, Ski, Pulks, and in practising the use of the same. Generally the child is left to itself, and it is but little troubled with chastisement or discipline. When Lapp children enter school they are like unbroken colts; either they are defiant, or seek escape in excuses. They are, probably in consequence of the lack of restraint, indifferent as to their parents, and entirely neglect them if property or other egotistical considerations do not influence them. Only unwillingly they take care of their parents in old age; they do it more from a sense of shame than from any feeling of affection. Old or decrepit people are much in the way of the Lapp moving from place to place, and for this reason they are rarely taken about, but either left to beg, or boarded in the family of Settled Lapps. Sometimes they are taken to the mountains, but then they are left in a separate, conveniently-situated tent during the whole winter, where they are visited from time to time by their far-roaming children. If a Mountain Lapp be taken ill, he is either carried with the family or left in the house of a Settled Lapp; but some-

required. They are paid in reindeer and clothes, and if fortunate, may have a snug little herd in a few years, when they become their own masters.

The physical characteristics of the Lapp are briefly these. He is short of figure, spare of body, and, as a rule, not more than four to five feet in height, the women being a trifle shorter. He stoops in walking, which makes him seem shorter still. The legs are very short in proportion to the body, and bandy legs are very common.

The colour of the skin during adolescence is light, there is a lively complexion in the cheeks, and the tint is clear. The women retain this bloom longer than the men, who lose it early. In men and old women the complexion is brownish-grey, a change which is, I believe, caused by dirt and the great contrast between the scorching heat of the fire in the tent and the icy cold without, and exposure to the elements of Nature. The hair is mostly dark, very bristly, and rarely curly. In old age the hair becomes slightly grey, but never white. The beard is very scanty; it is richest on the upper lip and chin, poorest on the cheeks.

The muscles, although not large, are well developed, and, in consequence of constant use, very pliable. The Lapp is fond of wrestling, which he practises with great energy and zeal, in fact all his movements are exceedingly graceful and bold.

Their mode of living is also one which requires great muscular exertion, a requirement as necessary to the woman as the man, their work being almost identical. The Lapps do not, however, possess great muscular

strength, and are incapable of any severe tussle. In this respect they are far inferior to the Norwegians, Swedes, and Finns.

Their eyesight is very keen, and they are, through constant practice, capable of distinguishing objects at a great distance. The mouth is wide, and the lips thick. The teeth are good and white, so white that those of some young Lapp girls might excite the envy of many a European lady.

The expression of the face is generally good and kind, almost childish; but the wrinkled eyebrows give it a certain melancholy cast. The voice is rather squeaky, the tone being thin and harsh.

The hands and feet are, as a rule, small, but the latter seem much larger than they in reality are in the large shoes. The ankles, on the other hand, seem unproportionately thin in consequence of the tightness of the breeches.

Lapps generally enjoy good health, and are seldom ill when they have fairly passed through the first stages of existence, and attain sometimes a great age. But time tells greatly on them, and it is impossible to guess their age from appearance; they look much older than they really are. This is particularly the case with the women, some of whom, when young, have a pleasing and comely appearance, but in old age become quite repulsive.

The Lapp does not recognise the truism that "cleanliness is next to godliness"; but the Mountain Lapp is to some extent excused, as he sleeps all the winter and part of the summer in his dress, in the winter in a skin with the hair inwards. The entire family lives in one

small tent; there is no room for proper washing; only the face and hands can be washed. Even if clean he is again

MIKKEL JOSEFSEN NECKELA (21).

in a few moments dirty through smoke, soot, and dust. Their neglect in this respect does not, however, contri-

bute to make them more ugly, in fact the dirt seems to act as a kind of varnish against wind and weather.

Combing is an act of cleanliness almost unknown to the Lapp, while the clothes are generally worn till they become rags, or the season demands a change. It is therefore not to be wondered at that they are greatly infested with vermin, particularly of that delightful species known as *Pediculus.* Some travellers assert that this is not the case, but my own experience points in a different direction. But the Lapp is as indifferent to this plague as to dirt. I have myself witnessed the most disgusting spectacles in this respect.

The Lapp must be said to be hospitable and kind, at all events as far as it refers to offering shelter, sleeping-place, and warmth. I have often seen one Lapp after another enter a tent uninvited during a snow-storm, and make himself at home. If one of them is known to the occupants he may be offered a cup of coffee or so; else he has to remain content with the fire and a drink of water. The Lapp is not the least ashamed of eating whilst a hungry man looks on.

The Lapps greet each other with "Buorre bæive"—i e., (liter.) Good-day,—to which is responded, "Ibmel adde"—i.e., God will grant it. This is followed by a semi-embrace, the right arm of each one encircling the waist of the other, hands being often shaken afterwards with several "Burist, burist"—All right, all right. When saying good-bye the Lapp says, "Batse dærvan"—Remain in peace,—to which the host replies, "Mana dærvan"—Depart in peace.

In their intercourse the Lapps are cheerful and very

talkative. When a man approaches a tent he increases his pace, arriving almost running, so eager is he for the meeting. At the door he throws down whatever he may be carrying, walks quickly into the tent, exclaiming with great animation, "Burist, burist," squats down on the ground, and is in a few moments engaged in the liveliest conversation.

No ladies' tea-party can be gayer and more animated than some Lapp's who have just met round a friendly hearth. If a stranger be present they may at first be a little reticent, but if the former be kind and communicative, or particularly fond of joking they soon change their front. They are never backward in replying. The Lapp is a keen humorist, and sharp in *repartee* and chaff.

The intercourse between the young of both sexes is perfectly unrestrained; men, women, girls, boys and servants sleep side by side in the tent. The natural consequences are, of course, obvious.

The Lapp is, as a rule, saving, almost miserly, as wealth is with him synonymous with position and respect; it may also be that he looks ahead for a rainy day. Formerly it was his custom to turn everything he could spare into silver coin, which he hid in a secret spot, and if he suddenly died the treasure was lost to his relatives. Many such treasures, no doubt, remain buried in the earth to the present day. Now he has, however, discovered the advantages of a banking account. Related to his sense of saving and suspicious nature is his attempt at extortion, although polite to the traveller. He is selfish and 'cute in all his dealings, and easily deceives his customer. If he understands that a person is anxious to

obtain a certain article, or can only get it from *him*, he will screw his price up to the utmost.

He has also a strong disposition to indulge in the pleasures of life, whether in the shape of a pipe of tobacco, a cup of coffee, or a glass of brandy. He appears, therefore, to take things very easy. Time is nought to him. He keeps no clocks, and does not

KAREN ASLAKSDATTER EIRA. RAVDNA ANDERSDATTER SOMBY. KIRSTEN PEDERSDATTER BALS.

reckon the time by the hour, but by the rising and setting of the sun and stars. His philosophy is: what you do not care to do to-day put off till to-morrow, or any future occasion when you may care to do it. In effecting a purchase, a work of any kind, or becoming one's guide, he requires plenty of time for making up his mind. He vacillates, changes his mind, and when

finally decided proceeds to carry out his task in the most cautious and slow manner. To make an agreement

MATTIS JOHANNESEN HÆTTA (60). A SETTLED LAPP.

of transport, to accompany a traveller, to break up camp, or any other work on a journey, are things which require

great deliberation to a Lapp, and tax the patience of a traveller to the utmost. No man must be in a hurry who has to live among and depend on Lapps. But to their credit I must say that when the decision is taken at last and the start made, they carry out their undertaking in a proper manner.

The Lapps are good-tempered, and any lasting grudge between people is most uncommon. The husband's treatment of wife, children, and servants is most humane.

The relation of the Lapps to the people amongst whom they roam is good. There is, however, one exception, viz., the strained relation between the Mountain Lapps and the settlers on the coast which they visit in the summer. The latter complain that their fields and meadows are trampled down by the reindeer, that the Lapps have extended their roamings to places where formerly they never used to come, and that it is impossible to get at the real offender, and obtain redress. The Lapps, on the other hand, complain that their pastures are narrowed year by year, that the few paths to the coast are being closed to them, that the settler shoots their reindeer, and that his dogs damage their herd. Each party claims to be right, and no doubt there is something to be said on both sides.

In fact, the peculiar characteristics of the Lapp may be recapitulated in the following brief delineation: he is a Savage, endowed with a mixture of goodness and vice, simplicity and cunning, sensitiveness and cruelty, indolence and energy, indeed, a true Child of Nature.

CHAPTER VIII.

ABOUT THE REINDEER.

THEIR IMPORTANCE TO THE LAPP—REMARKABLE YIELD—BUILD AND APPEARANCE—STRANGE SHAPE OF HORNS—THEIR GROWTH—REINDEER *versus* STAG—CURIOUS MARK OF OWNERSHIP—FODDER—REINDEER FEEDING—TAME OR WILD?—BREAKING-IN A REINDEER—A FINE HERD—A SPLENDID FOREST SCENE—A COMIC INCIDENT—SIZE OF HERDS—A RICH LAPP—ENORMOUS TOTALS—PRECARIOUSNESS OF REINDEER-RAISING—ENEMIES OF THE DEER—TRAVELLING WITH REINDEER—TRAVELLERS' TALES—THE SPEED—IN BAD WEATHER—AN EXPERIENCE TO BE REMEMBERED—MARVELLOUS FACULTY OF ORIENTATION—A NIGHT IN THE SNOW—THE SLAUGHTERING SEASON—*Oestrus tarandi*—KILLING A REINDEER—A CRUEL METHOD—LAPP DAINTIES—CHARMS OF THE NORTHERN REGIONS—THE CAMEL OF THE ARCTIC DESERT.

THE most important factor in the domestic economy of the Lapp is the reindeer. They are his fields and meadows, cows and horses; and from them he obtains every article which the townsman purchases at his stores. The reindeer furnishes the Lapp with food, clothes, and labour, it supplies him with milk, cheese, meat, and money. The skin is used for clothes and furs, the skin of the head and feet for shoe-leather, and from the sale of the products of the reindeer he obtains every other requisite, such as Vadmel for clothes and tent, flour, salt, spirits, tools, and nicknacks, while from the sinews thread is made by the women, and from the horns or bones tools and glue.

I intend in this chapter to describe these remarkable animals, which have an additional interest as being at one time found over the whole of Europe, but are now confined to the extreme North alone.

The reindeer, which is still found in a wild state in certain parts of the Scandinavian peninsula, is both in a wild and tame state a pretty and lively animal. The

TETHERED REINDEER.

tame full-grown deer is from 4 to 5 feet from the root of the horns to the tail, 3 to 3½ feet high and 1½ foot from the belly to the back. The wild one is a little larger. It is in build like the deer species, but its head is a little thicker, and the snout is like that of the cow, the shoulders a little high, forming a kind of hump, but the latter is so low that it is hardly noticeable. The summer

coat is dark brownish-grey, darkest along the back, which is also the case in the winter, when the coat is whitish-grey. Sometimes the colour is perfectly white all the year round, which is considered an advantage by the Lapps, as the mixture of brown and white enables them to espy the herd easier against the dark mountains. At the birth the calf is reddish-brown, and assumes next a dark brown hue, which finally becomes grey.

Outside the sockets of the eyes are always dark brown, and on the neck, near the breast, is a tuft of long hair. The snout is white, as is also the tail, which is about 3 inches in length. The hair on the legs is generally dark and on the fetlock white. The hairs, 1½ to 2 inches long, are in the winter rather close, bristly, and overlap each other.

The reindeer is rarely without horns; those of the ox are usually 2½ feet long; they point backwards until the middle, then again curve forwards. The antlers are flattened on both sides, and the points split. From the root of the horns a branch, sometimes two, slope down to the snout, vertically compressed at the point, but varying in shape. The span between the points of the horns corresponds generally with the total length of the same. Sometimes there is only one horn, sometimes three, one being in the middle, but they all vary greatly in form. The horns of the cow are smaller and thinner than those of the ox, and have fewer points.

The horns of the calf begin to shoot four to five weeks after its birth, and grow until October, when they are about 8 inches long. Those of the ox are fully developed at four and a half and those of the cow at three years of

age. The bullock sheds his horns in the middle of November, and they begin to grow again immediately after, being in April about 3 inches long, at Midsummer, half-grown, and at the end of August fully developed. The bull sheds his in the middle of April, and the cow hers in May, about ten days after calving, those of both being full-grown in the middle of August. When the new horns appear they are soft and covered with a fluffy, velvety coating, which is shed in August. During the growth the horns are very brittle and the coating extremely sensitive. They grow more in length than in thickness.

The reindeer becomes seldom older than fourteen to sixteen years of age, but it may attain twenty years. It is full-grown when four to four and a half years old, and after this age the horns do not change in size or form. It is, therefore, impossible to judge the age of the reindeer by the number of its antlers, as is the case with the stag. The horns are, however, not equally large every year, a variation which may be caused by the change of fodder and disease.

The rutting season falls in September and in the early part of October. At the end of May or early in June the cow generally casts one or two, seldom three calves.

In the autumn the calves are marked by a slit being made in the ear. The mark thus made is one identified with a certain Lapp family, and is the only, but undisputed, proof of ownership.

The reindeer very rarely emits any sound; it may be compared to the grunt of a pig.

The most cherished food of the reindeer is the moss

named from it, *Lichen rangiferinus*, but it eats also greedily grass and hay, or nearly every kind of vegetable. The animal finds its own food, and no fodder is collected by the Lapps, except on a Pulk journey. Even if the ground be covered with deep snow, the reindeer will find the moss by digging a hole in the snow with its broad, spade-like hoofs. But when the surface during the fall becomes like a sheet of ice, through thaw and a subsequent frost, the animal is unable to get at its delicacy, and has to remain content with moss on trees, young sprigs, &c., and it then sometimes happens that it dies from starvation.

The reindeer of the Lapp is called a domestic animal and tamed, but it is a domestic animal which is never under shelter, and the herd is, as a whole, far from being tame. A man may certainly walk into a flock and without danger pat a deer or feel its horns, but the moment he attempts to catch the animal the whole herd flees with the speed of the wind. And how could the reindeer be tame? Man never feeds it, never keeps it long in his possession; he urges it on, sets the dog on it, and never shows it the least kindness.

As beasts of burden only oxen are used, which are broken in in their third or fourth year. To break in a young full-grown bull is a task which demands patience, strength, and skill. At first he cannot bear the Pulk behind him, and, in order to accustom him to it, long reins and running strings are used in the beginning, until he is at last broken in. Sometimes he is also broken in by being tied to a heavily-loaded Pulk drawn by an old trotter, and although he resists and kicks at first, he is

obliged to follow, and thus at last gets accustomed to the Pulk.

A large gathering of reindeer is a fine and magnificent spectacle. On one occasion four "Byer" were driven together in a woody district, and they looked grand indeed. The total number was about 1700 animals, but among the trees the number seemed double, and the wood and mountain seemed to take life. At one moment they seemed as if about to lie down by the tents, when they suddenly raised their eyes to a high, forest-clad mountain, where we too now saw something move. The movements increasing, we could soon distinguish the herdsmen and their dogs, and shortly after we heard their shouts and the barking of the latter.

In a few moments some hundred deer came racing down the slopes, their crests raised nobly aloft in their wild scamper, while the forest and the glens seemed to intensify their bold movements. Forward they rush unstemmed, by a few rapid movements they avoid the jagged rocks, and disappearing behind them for a few seconds, again come rushing into view. Now they are but a hundred yards distant, still they rush madly onward: their gallop sounds like an approaching tornado in the Tropics; and in the next instant they come up with the herd around the tents, which, frightened by their rush, scatter in all directions. The dogs are far behind.

Guiding and shouting the Lapps follow on the Ski, urging the dogs on. A quarter of an hour after the whole herd is quiet, at all events as far as reindeer can be.

Through a sense of vanity and fondness of hearing his own voice, a dog pursues a stray deer after it has

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A REINDEER HERD FEEDING.

regained the flock. Quickly the reindeer turns, gives a thrust with its horns, and the little wretch lies sprawling on his back. Now is his turn to fly, which he does, too, with his tail between his legs, whining loudly. The reindeer looks for a while reflectively after him, as if thinking, "Outside the herd is *your* place, within it you have no business."

According to one of the best authorities, a Lapp is rich who has a herd which can bear the slaughtering of 30 to 40 full-grown deer a year, viz., the number of animals an ordinary family consumes in that period, in addition to some 20 sold or bartered away. To stand such a strain, without diminution, the herd must number about 300 deer, including the calves and the animals used for driving. Such a herd may be estimated to contain about 100 full-grown cows, 30 to 40 bulls, and the rest calves. Supposing that each cow yearly bears one calf, the owner has in the spring 100, but of this number barely half live to see the following winter, as a great many are destroyed, and some must be killed for furnishing clothes to the children. The herd is thus strengthened with about 50 deer every year, making up for those which are eaten, sold, lost, or killed by wolves.

There are wealthy Lapps who possess from one to two thousand reindeer, or more. The richest of them all was Per Banner, of East Finmarken, who once could boast of 8000 animals! The total number of tame reindeer in Norway at present is estimated at about 100,000 and the total number in the whole of Lapland at about 400,000.

In Koutokæino I could buy a draught reindeer for about a guinea, and one for slaughtering for a little less.

Although a Lapp's wealth may thus amount to a considerable sum, the tenure is very precarious. Besides the above-mentioned circumstance that the snow sometimes becomes covered with a sheet of ice, other natural causes destroy the deer, as, for instance, winters when the fall of snow is very heavy. Even a yearling may then be unable to reach the moss, and has to resort to that left in the holes by the older deer, and many then die from starvation; or when the spring comes very late, and the cows have to feed above the snow, the want of food makes them unable to sustain their young. Certain diseases may also greatly reduce the herd. To these may be added his enemies of the animal world, the "Jærv" (*Gulo borealis*), and in some districts the bear, and, above them all, the arch fiend of the Lapp, the wolf. This beast will in a single night make a terrible havoc among a herd.

I have in another chapter described driving with reindeer, and will here only make a few additional remarks.

When moving, as well as when going to fairs, the Lapp requires several loads, which he forms into what he calls a "Raide." At the head a Lapp drives in an empty Pulk, to which is attached a reindeer with a load, to this one another, and so on—six to eight in a string. I have sometimes seen up to fifteen. If a family travels, and there are many loads, several such "Raider" are formed. Behind the last Pulk in the Raide a loose reindeer is tied, which acts as a drag down-hill, or the reserve deer, as the others sometimes become exhausted before reaching the destination. Also when people travel the drag-deer is used. If

travellers are unaccustomed to drive with reindeer they are placed in a Raide, the rein of each animal being tied to the Pulk in front. In this case the Lapp guide, called "Vappus," a corruption of the word *oapes*—guide or pilot—drives at the head, steering the whole Raide.

The Lapp never drives with more than one reindeer, and very seldom more than one person occupies the Pulk, children excepted. Even if not in a Raide they always drive in a line, chiefly on account of this mode making the track in the snow hard for those behind. The reindeer are so accustomed thereto that even on a plain or a lake, where the surface is as hard as flint, one follows exactly behind the other, it being almost impossible to force them to make a "short cut." It is impossible to drive with reindeer on ice, as they cannot stand on the slippery surface.

To travel with reindeer is very fatiguing, and also somewhat expensive to one with much luggage, as one animal can draw but a comparatively small load, and the number of drivers increases with that of the animals. About two cwt. is considered a fair load for a reindeer, but it can, for a shorter distance, and where the road is good, draw considerably more.

The rapidity of travelling with reindeer is certainly great when the snow is good and the animals fresh. But there seems to be a belief in some people's mind that the speed is equal to railway travelling. It is no doubt the idea of associating the reindeer with the swiftness and agility of the species of the stag tribe which has contributed thereto, while many travellers, who have undertaken the journey to the North Cape—anticipating

stirring adventures—in vain, have done their best to confirm the belief among those who "have not been to the Cape." But if one learns that the animal from which such performances are expected is in size and strength not much beyond a young colt, it becomes obvious that its speed with a Pulk over rough country is considerably less than that of the Iron Horse. To run, unfettered by the slightest burden, is a different thing to dragging a Pulk and a full-grown man ninety or a hundred miles through deep snow.

When the snow is hard and the track level it is certainly possible to do ten miles in twenty minutes, but this rate is an exception, and cannot be kept up for any length of time. As an example I may mention that the journey from Alten to Koutokæino, or from Koutokæino to Karasjok, a distance of about a hundred miles by the route, is performed without change of reindeer in one and a half or two days, according to the season and the state of the snow. I believe it would be impossible to perform the journey with a horse in that space of time, in spite of its greater strength, the reindeer possessing far more stamina.

After about three hours' driving the reindeer are unharnessed at some place where they may either find or obtain moss. They are then allowed a good feed and rest, the latter lasting, in the night, for several hours.

On the top of a bare mountain ridge the track is generally good, as the wind either sweeps the snow away or compresses it to a hard crystalline mass; but in the valleys or glens which one passes, on rivers, or where the underwood arrests the drift-snow, the snow is so deep and

loose that the reindeer sinks down to the shoulders, and only gets on by rising itself on its hind-legs and jumping bit by bit. That this is very fatiguing to the animal and permits it only to move very slowly, is evident.

The most annoying casualty which can befall a traveller in Lapland is a thaw. Then the snow adheres to the Pulk, to the boots, and the hoofs of the reindeer with a tenacity which is enough to irritate the most patient, and which delays the journey for hours. It is not only necessary to get out of the Pulk every moment to let the Lapp scoop the snow away from the bottom, but sometimes the great fall of snow on the ice in the rivers weighs on the ice to such an extent that the water is forced above it. In such a slush the traveller may at times spend hours, or even a whole day.

Travelling with reindeer in bad weather is always annoying, but the unpleasantness is never felt more than in such weather. It can only be lightly compared to that of lying in mid-ocean in a dead calm.

What it is to endure storm and snow on the barren mountains of Lapland in the depth of winter, in uncertainty of where to find food or shelter, only he who has tried it can realise, and if the traveller has under such conditions to spend a night in the open without tent or fire, I warrant he will never forget it, if he ever lives to remember it. Sometimes it is then necessary to bury oneself, or rather be buried, by the snow, but this is certainly an experience which is accorded only to a few. Generally the Lapp gropes in the storm and darkness until he finds one of the mountain refuges, and however wretched the accommodation may be, it will at that moment, to the

half starved, benumbed traveller, compare favourably with the finest hotel in Europe. Here shelter, a fire, and hot food, followed by a sound sleep, may be got, while the terrible wind from the North Pole shakes the stones and piles the snow above the chimney with a savage growl.

That a Lapp can find his way on a mountain stripped of every tree and shrub, and where there is no road, or even path, seems almost incredible. But it is nevertheless a fact, and a fact which allows of an explanation. The secret is, that every human being, with ever so low faculties, can attain perfection in one particular avocation, if his whole mind be concentrated on its attainment. Every man finds his home, be it ever so dark; and the mountain is the home of the Lapp. He passes his whole life in moving from spot to spot on its crest, his tent has been pitched in a thousand places, and as he has nothing else to engage his attention, he engraves every detail of its structure on his mind. Under yonder brow he once pitched his tent, and from that brook he fetched his water, at this solitary shrub he tied his reindeer, and between those bushes he set his ptarmigan snares—he knows every object at a glance.

I have thus seen a Lapp after crossing a big snow-covered lake, where nothing but the wind could guide him to the opposite shore, on reaching it, scoop the snow away with his foot until it touches a stone or the stump of a tree, reflect for a second, as if thinking: Where did I see you last?—and he knows where he is. Of course, not all possess the same faculty of orientation, and on the bare mountain wastes, offering no characteristic landmark, one

has often to drive at random, and unnecessary detours are often made; but sooner or later one comes across some object which makes the Lapp at home in an instant. But it does happen, in very bad weather when the biting north wind churns the snow into crystal dust, that the track is lost, and it is then that the traveller has to spend the night with heaven for a roof, and lie down amongst the fatigued animals with a stone for a pillow, while the snow wraps its white pall around man and beast.

The slaughtering season for the reindeer is from October to March. Early in the fall the animals are lean, and the holes in the skin from the stings of the reindeer fly—*Oestrus tarandi*—not yet closed. This insect lays its eggs among the hair of the reindeer, where the *larvæ* bore themselves into the flesh. Before the chrysalis state they leave the animal. If therefore, a reindeer be slaughtered in the summer, the skin is, particularly at the back, perforated in innumerable places through this cause.

Later on in the winter the reindeer again fall off, the skin becomes thin and the hair is shed.

When a reindeer is about to be killed the Lapp lays hold of both horns, throws it with a sudden jerk on its back, draws his long sheath knife, and plunges it to the hilt into the breast or sideways into the shoulder. In both cases the heart is pierced. He then slips the deer, which makes a sudden bound into the air, but it soon begins to feel the knife and its consequences; it begins to tremble, tries to stand, but the legs will not do their duty, and it sinks to the ground. As soon as it has expired the knife is drawn out. Not a drop of blood flows from the wound,

all collects in the breast-cavity. When the animal becomes cool it is flayed, but the skin on the head and legs is left for a time, as these parts have a special use. The skin on the head is used for Skaller, or winter-Komager, and that on the legs for winter-Bællinger or gloves.

The skin of the trunk is at once stretched on a pole with cross-trees, and the smaller parts on little bits of bark or wood. The intestines being taken out, the trunk is limbed up, in which operation the Lapp uses his knife alone, each joint being skilfully dissected. Finally, the flesh is cut from the bones, and the larger pieces hung up to dry.

Nearly every part of the reindeer is used for some purpose or another. The fat tongue is considered a great delicacy by Lapps, as well as Europeans. This is also the case with the marrow. The knuckles are, when the flesh has been removed, boiled for a short while—not long—and then crushed whilst hot, whereby the marrow is obtained. The taste for reindeer marrow is like the taste for oysters, an acquired one. At first it tastes nasty, but it comes with eating, in spite of the uninviting way in which it is served and the unpleasant surroundings.

The reindeer as well as the Lapps lend a peculiar and strange charm to these northern regions. Whether speeding along in the Pulk behind this little horned steed, or watching the Raide wind its way through the glistening snow, or the herd in thousands swarm among the underwood of the mountain, or their grand crested heads like a floating forest above the waves of the Arctic Ocean—one feels that one lives in a foreign world,

in which the Past lives in the Present and whose shores the levelling Wave of Civilisation has not yet reached.

The field and store of the Lapp, his cow and his horse, reared in snow and cold, hunted by beasts of prey, suffering hardship and toil, a stranger to kindness and caress, repaid with blows and death—such is the existence of the reindeer, the Camel of the Arctic Desert.

CHAPTER IX.

IN THE LAND OF THE LAPPS AT CHRISTMAS.

NIGHT IN MIND AND NATURE—A GREAT TEMPTATION—A TRAVELLING EPIDEMIC—LONGING FOR THE SOUTH—MY CHRONOMETER REMONSTRATES—A SOLILOQUY DURING THE POLAR NIGHT—THE CITHER PLEADS—THE CHRONOMETER AGAIN REMONSTRATES—THE MUSICAL BOX INTERPOSES—DAYS OF DEPRESSION—A WELCOME ARRIVAL—A GRAND PYROTECHNIC DISPLAY—TERROR OF THE LAPPS—HOW THE DEAD ARE DISPOSED OF—IT IS CHRISTMAS EVE!—IT IS CHRISTMAS DAY!—FESTIVE PEOPLE—A CHRISTMAS SERVICE—LAPPS SINGING—WANT OF MUSICAL EAR—"JUÖIKING"—A STRANGE SERMON—FANATICAL EMOTIONS—REMARKABLE ABSENCE OF TRADITION—BAPTIZING—NAMES—THE FUNERAL SERVICE—A SACRILEGIOUS DUTY—RISK OF DISTURBING THE DEAD—A NIGHT EXPEDITION TO A LAPP GRAVEYARD—WAITING FOR THE GHOST—THE CHRONOMETER TO THE RESCUE—A LAPP WEDDING—LOVELY COSTUMES—A SPLENDID CROWN—THE BRIDAL PROCESSION—VISIT TO THE BRIDAL HOUSE—CELEBRATING A WEDDING—*BRÆNDEVIN*—UNSENTIMENTAL LOVERS—"POPPING" THE QUESTION—A MAN OF BUSINESS—IS THE LAPP A DRUNKARD?—A LAPP SCHOOL—PROGRESS OF EDUCATION—LAPP VESTRY MEETINGS—THE MYSTERIOUS STRANGER FROM THE SOUTH—"OILING" MAKES FRIENDS—SILENCE LOOMS AGAIN OVER THE LAND—PROMISE OF DAWN.

DARK, sad, gloomy and depressing has December been. A continuous Night in mind and Nature. Only a few hours' faint dawn in the middle of the day has told us that the sun is not dead, but that the time will come when the glorious orb shall again rise above the horizon and shed vivifying warmth and animating life on the *triste* monotonous winter's shroud which has for months covered

the land and the human soul. For a long time, too, as if the light was not faint enough, a heavy, depressing mass of clouds has covered the sky and hidden from view the lovely twinkling stars and the glorious Aurora Borealis.

When the sun is absent, and the charming nocturnal display of light is hidden from view, the desert is shorn of every attraction. A storm, or even a fall of snow, would bring a welcome change into the gloomy monotony, which broods over land and mind; but the air stirs not, and the clouds move lazily over the heavens without discharging their heavy loads.

And Nature's gloom stamps the human mind. The warm blood of the Southerner is nourished by the glowing sun, and his imagination reflects the golden and rich luxuriance of the varied nature before his eye; and here under the dark and gloomy winter's sky of Ultima Thule, the bright flowers of the soul are buried together with those of the field, and the well of emotions dries up like the stream yonder, and the thoughts drag as heavily along as the dull mass above.

In the first half of December in particular the solitude and monotony were almost unbearable, in spite of the fact that the few previous months had given me a considerable amount of practice in being content with my own company, and reducing the desire for society and enjoyment to a minimum.

During this period I was the only man within a radius of some fifty miles from Koutokæino. Everybody, both Norwegians and Lapps, had left to attend at the great event—the only one of the season—about which so much

was talked long before and after it took place—the fair at Bossekop. I must admit that I felt greatly tempted to pay a flying visit to the oasis of civilisation on the Arctic shores, particularly as the fair offered an excellent opportunity for the study of national life; but I felt bound not to leave my post, and I remained behind in grand solitude to amuse myself with the study of the sky and the snowy wilderness around me.

A travelling epidemic seemed to have broken out among the population, attacking both the Settled Lapps at Koutokæino and the nomads in all other parts. There seemed to be no end to the long Raides passing; from morning to night we saw long lines of them make for the river, loaded with reindeer skin, meat, and other articles, which at Bossekop should be transformed into shining silver or be exchanged for the three articles of luxury which have become a necessity to the Lapp, coffee, sugar, and tobacco.

Alas! how I thought in my dark solitude of the lighted streets in the South, with the gay throng, everybody making preparations for and looking forward to the jolly Christmas near at hand. What would I not have gladly given for a few hours among them, joining in their mirth! What would I not have given for a moment in the cosy home of my friends there, where old become young in anticipation of the coming festive season! But the chronometer says, "tick—tack, tick—tack; away with your illusions, attend to your duties. Do not look right or left, you see only the delusions of a *fata morgana*; let *your* life's clockwork go on as undisturbed as *mine*, all is vanity,—tick—tack, tick—tack."

"Take me away from this terrible, overwhelming solitude," pleads the cither. "Come, let us fly to my lovely home, where the silver-crested peaks bask in the purple glow of the sun, where the gay brooklet relates fairy tales to the blushing flowers of the valley. Away, away, from Nature's grave and her chilly white shroud, away to the warm and fertile South, to gardens where the rose blooms and song enchants!" Its melancholy song suddenly ceases—a string has burst.

"Tick—tack, tick—tack," remonstrates the chronometer. "You silly useless thing! When your warblings cease what is *your* use? No, listen to this melody, tick—tack, tick—tack, which I sing from morning to eve, day and night, always the same, not changing a single note. It is the regulating melody of the life of Necessity, the melody which cheers the sailor on his voyage across the ocean; it is the pulsation in the breast of real Life. Tick—tack."

"Poor cold machine! You do not know that Life is not a clockwork alone, driven by the springs of Necessity. Your mathematically adjusted wheels and revolutions, which *you* call the heart of Life, are ignorant under their forced, monotonous motion of the world of emotions without, where melody vibrates and swells, where colour speaks and beauty lives in form, where song flows through golden vistas borne on the wings of delight."

"It is humbug; it is the outcome of the poetical mind of a sentimentalist, gaudy tinsel. No, stick to the prosaic road of real Life, and keep time to my tick—tack, that is the only sensible thing here in life, the only thing which lasts."

"Allow me a word," says the musical box. "You are right and wrong both. Look at me. I am, like you, stern chronometer, a machine of wheels and revolutions, but nevertheless enchanting notes issue from my breast. One must not look at life from one side only; neither be carried along with the Malström of materialism, nor leave the earth in a balloon of emotion and fancy. Life is a mixture of Prose and Poetry, and only he has rightly understood it who blends both in harmony. Poetry throws her veil of beauty over the face of stern reality; but Prose forms the solid stem around which the muse winds the garland of fancy."

Darkness looms over the snowy waste; darkness in the mind. With the exception of the faint glimmer of light shed over the landscape at noon, time is a single, long, long night. Lamps and candles are always kept burning in the houses, a poor substitute for the light Nature has deprived us of.

I attend to my monotonous duties, and read the instruments regularly by the faint rays of a lantern. One day comes and goes as the other, and slowly the hours roll by for the hermit in the wintry desert.

Under these circumstances it was no wonder that I received the people returning from the fair with open arms. Besides, they brought with them an intellectual treasure in the shape of the vicar at Koutokæino, who had been absent ever since my arrival. In their honour I let off the first rockets and squibs which ever ascended in this part of the world, a display which created the most profound astonishment and terror amongst the Lapps.

With the arrival of the clergyman a new element, viz., the religious, was introduced into our life. Hitherto the bell had only on a few occasions sounded across the white fields, when a dead body was deposited in the mortuary chamber. As the clergyman lives here in the winter only, funerals, as well as weddings and christenings, can only be performed during that season, and as the scythe of Death is busy all the year round, the dead may sometimes wait a long while before being consigned to their last resting-place. The Mountain Lapps are obliged to deposit the bodies in some place in the open air, formerly in a Pulk, but now generally in a home-made box, until they have an opportunity of getting them to the cemetery.

The small mortuary chamber, situated in a corner of the churchyard, was therefore nearly full when the vicar returned.

It is Christmas eve! At least so the Almanack says. But the eye will search in vain for festively lighted rooms, where happy children dance around the gaily decorated Christmas tree, as is their wont in most northern countries. The Lapps lie in their dark, dirty hovels, clad as on every other day in the year, living, thinking, and feeling as at every other season in the year. Even in the Norwegian homes there is little difference from any ordinary evening in the year.

The full moon sheds a pale light from between the heavy clouds over the white graveyard of the land where Nature has gone to rest, and where the huts of the Lapps stand forth like black tombstones. No sound of festive mirth breaks the dead silence. Still, it is Christmas eve.

It is Christmas day! The bells chime merrily from

the little church across the white fields, while the smoke from its chimney curls straight into the clear, cold, crisp air. The little cluster of birch trees near stand covered in a veil of filagree crystals, which sparklingly reflect the faint light in the south. One flock of peculiar, fur-clad individuals after another move up the hill to the church. From near and afar they have gathered for Christmas, some to hear a sermon, some to bury their dead, some to christen their children, and some, perhaps, to make an offering to—Bacchus.

Christmas and the Assize days are the only times when all the Lapps of the district meet at the church.

Everyone is dressed in the same clumsy garb, and even the latest additions to the tribe, which the mothers carry to be baptized, appear in Pæsk and cap. The women have for the occasion decked themselves with their gaudiest shawls, and their finest belts and ornaments.

The church is quite crowded. In the middle is the oven, and on one side the men are seated, on the other the women. The Lapp verger steps forth from the vestry door and reads the Lessons in the tongue of his forefathers. The only difference in his dress is, that he wears a summer frock. He then calls out the number of the Psalm in the Lapp Prayer Book—in main a literal, unversified translation of the Norwegian—and initiates the singing. Only few members of the congregation join in it, and their contribution does not add to the harmony. This part of the service is not very impressive, and does not seem to have any stirring effect on the congregation, the greatest number of whom appear indifferent to the drawling song of the few.

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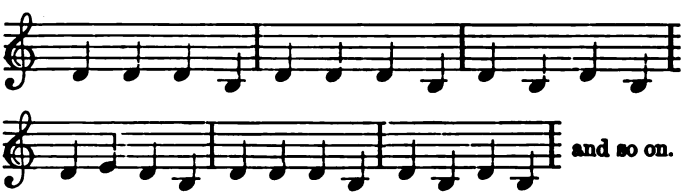
OUTSIDE KOUTOKÆINO CHURCH ON CHRISTMAS MORNING.

The Lapps are accused of having no ear for music, and I must admit that there is a great deal of truth in the assertion. They cannot claim to possess a single instrument of their own, not even the most primitive—if I except, of course, the single-noted willow-flutes which Lapp boys, like all other boys, make themselves,—and neither have they adopted those which satisfy the musical yearning of the Norwegians, Swedes, or Finns. The world of music is a *terra incognita* to the Lapp. The only approach to singing he knows is the so-called "juöiking," a kind of jodeling; but as poor compared to the sonorous notes which the echo of the latter creates among the mountain walls of the Alps as the barren nature of the Finmarken desert is to that of the lovely Tyrol. The melody, if it can claim such a name, is a monotonous chant of two or three, at most four, notes, the words being improvised, which are constantly repeated while the singer describes nature, the characteristics of men and women, &c. There is as little poetry in the words as melody in the song.

Of the many variations I have heard the following may serve as a specimen :—



The length of the song is naturally *ad libitum*. As an example of the want of musical sense I may mention that when six or eight "juöikers" sing in chorus, there are

not two who keep tune; each one has his own, either a pitch higher or lower than the others. My experience is, that the more *Brændevin* a Lapp, man or woman, has drunk the more he is given to "juöiking"; in any case, the chant is always the companion of drink, but it cannot, on the other hand, be asserted that the "juöiker" is always intoxicated.

The Lapp is, in spite of this, I believe, not quite deaf to the charms of music, and if the race does not show any strong musical sense it is, I believe, due to their hard and peculiar life. In the schools it has been shown that Lapp children may possess an ear for music, as well as a voice, and I have myself observed how enraptured and attentively Lapps have listened to my cither—the only instrument in the whole province—when playing some of the charming airs of Tyrol or Steyermark. They have, too, fallen into ecstasy over a musical box; but I admit that it may have been rather the strange, wonderful novelty which attracted their attention than the music.

But to return. The church service is conducted as in most Norwegian churches, with the exception that the language is Lappish. The sermon is, however, generally read in Norwegian, and interpreted by the verger, who stands in the vestry door, or by some able Lapp. The vicar has, therefore, to arrange his text so that he reads only short phrases at a time, which are rendered by the interpreter in Lappish before he proceeds further.

To act as interpreter is no easy task, partly on account of the wide difference between the two languages, and partly by the great difficulty in making ordinary

THE INTERIOR OF KOUTOKÆINO CHURCH.

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theological expressions clear to the Lapp mind. The vicars do not stay long enough in these inhospitable parts to learn Lappish thoroughly, and, on the other hand, few Lapps understand Norwegian.

As the service is drawing to a close crying, sighs, wails, and even shrieks, may be heard from the female portion of the congregation, but they generally emanate from old women. It is, however, very characteristic of the Lapps that they are, now perhaps less than formerly, given to strong religious emotions, which may at times assume the form of a fanatical frenzy.

The old heathenish religion of the Lapps is dead long ago. They have not even retained the traditions of it. The Lapp has in fact a short memory, both individually and collectively. Very seldom he has any recollection of his grandfather, so that it is not strange the tribe has forgotten all about times gone by. And again, just as the race has no other literature than that supplied by Scandinavians in modern time, it has no history. Its history is only the traditions of their wanderings collected by the neighbouring races.

A great many children were christened that Christmas, and Lapp children cry, I found, under this performance as much as most others. The Lapps have, as may be noticed from the names to my portraits, generally, not only a Christian and a surname—with the appendix,—*sen* (Sön), (English, son) or—*datter* (English, daughter)—but also a family name. The family name most common at Koutokæino is Hætta, a name which is derived from a Finnish family, which years ago emigrated from the village of the same name (Hätta), in the Finnish

Lappmark, to Koutokæino, and intermarried with the Lapps.

The coffins in the mortuary chamber were let down into the graves dug the previous summer or autumn. They could only be filled the following spring when the earth is thawed. The burial ceremony was the same as that observed in Lutheran countries, the heathen rites formerly attending this act having entirely disappeared with the pagan religion.

In the autumn, by-the-bye, I unearthed a few skeletons in the old churchyard dating from this era, for the purpose of obtaining some Lapp *craniæ* for the Museum at Bergen, but besides bones and some remnants of Pulks, and the roofs built over them, I did not find a single object of the kinds which in pagan times were buried along with the dead from some superstitious motive or another.

I knew that some years ago a zealous ethnographer, who plundered a churchyard in Russian Lapland for the purpose of enriching his collection, had a narrow escape of being drowned. The infuriated natives set upon him, and ducked him several times in the icy waters of the river. In order not to run a similar risk, or cause any offence to the Lapps about me, I conducted my operations with the greatest secrecy, although I had the representative of the Crown at my side. My assistant, the Lapp gravedigger, was bribed to secrecy, and the remains—a complete skeleton and four *craniæ*—were transported to my residence in the middle of the night.

I must say I experienced some scruples in disturbing the old Lapps, where they had rested for two centuries

at least; but what will not a *savant* submit to for Science? The bones stood for a time on the loft near the entrance to my photographic chamber, where I had to pass them several times a day, and I could not help casting a suspicious glance at them after dark, expecting to see them rise in anger against the sacrilegist.

In the night too, when listening to the smart cracks and marrow-stirring creakings of the woodwork of the house, through the intense cold, I often thought, here they are! But the chronometer by my side reasoned, "tick—tack, tick—tack, *phosphate of lime* does not play such pranks."

I did, nevertheless, not feel at ease until they were out of the house, and I had, in order to get them conveyed to Bossekop, to label them "Books and Old Newspapers." Had the contents been known they would never have reached their destination.

During Christmas I had also an opportunity of attending a Lapp wedding, and, although the levelling influences of civilisation have caused many of the customs formerly observed to disappear, the ceremony is still very interesting.

The bride is dressed in a costume which by the Lapp is considered to be the grandest and most brilliant toilet the human mind can conceive. It may also be examined with delight by those more fastidious. The striped, tasteful frock, with bright borders, is brand new. Around the neck and shoulders the customary many-coloured woollen shawl is worn, but over it is cast, in the most coquettish manner, a gaudy silk wrapper, the intense colours of which, yellow, green, and pink, throw the other entirely into the shade. Over this is again laid a silk

scarf with various colours, which is fastened with a brooch on the breast, and a showy necklace of silver ornaments is hung around the neck and shoulders; to crown it all

LAPP BRIDE AND BRIDEGROOM FROM KOUTOKÆINO.

the hands are kept in a kind of muff, formed of a large variegated plaid.

But the gem of the whole is the headgear. It is a kind of crown, but differing greatly from those worn by the peasant women of Scandinavia on such occasions.

The Lapp bridal crown is formed of coloured silk, strings of pearls, and silver ornaments, closed above with a bunch of flowers and silver-gilt leaves, while a number of long many-coloured silk ribbons of various patterns and width descend from the top down the neck.

The bridegroom is clad in the usual blue summer coat with the broad, silver-laden belt, but the diploma of his dignified position is a narrow, white band laid around the neck and cross-wise over the breast, the ends nearly reaching to the ground.

These bridal costumes are chiefly characteristic of Koutokæino. In the church is also preserved a large square piece of red cloth, which used to be carried over the bridal couple during the ceremony by two youths and two girls. This custom, only in vogue in Koutokæino, is however now obsolete.

Few Lapps possess a crown; it is, generally, hired from those who do.

After the ceremony we all walk in procession, two and two, to the house where the marriage feast is to be held, and until it is reached the bells keep on ringing merrily.

A great many Mountain Lapp visitors stay with their Settled relatives, where also, by-the-bye, their children board whilst attending school. In the houses of the latter weddings and other festivities of the nomad Lapps are also generally held.

In the evening I paid a visit to the bridal house, but I must confess I found little to attract me. The low, dark, and narrow room was filled to suffocation with Lapps, all of whom seemed to have but one common object in view, viz., to get another glass of the intoxicating nectar

poured forth at a table in a corner. *Brændevin* (diluted spirits) is an indispensable requisite at a Lapp wedding, as the number of guests and their generosity are in exact proportion to the quantity of spirits offered. The custom is thus, that every guest, invited or not, make their presents in money or natural products, chiefly reindeer, and it is no small wealth a couple with plenty of *Brændevin* may receive on such an occasion. Generally a kind of herald is chosen, who announces in a loud voice the gift of each person, as it is presented, which is accompanied with a good deal of chaff.

I walked boldly up to the table, where the couple sat in all their grandeur, and proffered my modest tribute in silver, in return for which I had to empty a couple of glasses of that terrible mixture which the Lapps prepare from raw spirits and water. The Lapps, however, consider this drink preferable to the finest champagne, to which the half-tipsy men and women, the noise, laughter, and "juöiking" might indeed testify.

The feast was not one of the most inviting. Imagine a dark and dirty room full of semi and wholly intoxicated men and women in strange garbs, over whom the fire throws a flickering lurid light, and add to this loud laughter and savage shouts, which a Red Indian might fail to cap—and you have the festivities of a Lappish wedding.

It is very remarkable that the Lapp knows no dances, although it may be admitted that his dwelling or his tent would make but a poor ball-room. They have no games or play either; even cards are little known among them.

The Lapp's relation to his sweetheart or wife is not of an erotic or sentimental kind. The "popping" begins generally by the lover attempting to take possession of his Dulcinea's furry gloves, and her answer is indicated by the willing, half-willing, or unwilling manner in which she submits to the robbery. On marriage he looks with the eye of a man of business. Disappointments in love, unhappy unions, or unrequited affection are utterly foreign to him.

As to the spirit-drinking vice of the Lapps, it may be summarised in a dozen words. The Scandinavian drinks, as a rule, half a pint of spirits a day, viz., two gallons a month; the Lapp drinks half a gallon a month, but this he takes *at one sitting:* he is called a drunkard.

It is quite true that Lapps, women as well as men, are very fond of spirits, and few can, I must say, resist it when offered; but it does not follow that they consume large quantities. The fact is, that the Lapp very rarely has *Brændevin* in his house or tent to drink; this pleasure is reserved for fairs and visits to the church-village, and when there he indulges therein to his heart's content. He drinks, however, far less in a year than a Norwegian.

At Christmas the children began again to attend school, under the tuition of the tall, stout verger, Morten Clementsen, and the excellent, kind-hearted Henrik Pentha, both Lapps, whose portraits I have great pleasure in presenting.

These worthies are hard at work from Christmas to Easter, imparting to their disciples, amongst whom there are bearded men twenty-five years of age, a little religion, writing and reading, and the rudiments of arithmetic;

in fact as much of the three "Rs" as their own education may permit. It does not go much farther. The third teacher is the vicar, who confirms the children. It is a creditable fact that, in spite of the short and desultory teaching, only a few weeks for each child, by far the greatest number of Lapps can now read, and a good many even write their own language.

The Christmas week was also utilised for settlement of various parish matters relating to the school, taxes, and the poor. The body managing these things was, with the exception of the three Norwegian residents, all Lapps. The members used to squat or lie on the floor, smoking, chewing, and spitting. Any other proceedings I never observed, may-be, through the impossibility of a man with ordinary olfactory senses staying in a room full of Lapps for any length of time. They carry with them a peculiar smell, composed of many ingredients, which is far from pleasant, and, in a small room, simply unbearable. Often I mustered up courage to attend these meetings, but my heart failed after a stay of a few minutes in the room.

What a number of visits I received daily from our Lapp visitors! They had all heard of the wonderful man who did nothing but stare at the sky, and they looked with awe at my strange instruments. Our vocabulary was certainly not a very copious one, but with the aid of hands and a little mimic we managed to carry on a pretty fair conversation, and the Lapps became particularly animated when I "oiled" their tongues with a glass of brandy. It was the surest way of making them return in a few hours.

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THE TWO LAPP TEACHERS AT KOUTOKÆINO.

All our Christmas guests have now departed for their reindeer camps. Silence looms again over Koutokæino. But the shortest day has gone by, and the promise of coming dawn in the south grows day by day greater. In a few weeks we shall again see the sun raise his golden crest above the rim of the horizon. Then life will assume a brighter aspect in the snowy desert of Ultima Thule!

CHAPTER X.

ON THE AURORA BOREALIS.

I HAVE hitherto only made a cursory reference to the Aurora Borealis, which was the real cause of my journey to the Lapland deserts, and, in consequence, also of my writing this work, in order to devote a chapter for the complete exposition of the position which Science at the present moment occupies in reference to this phenomenon. I will not tire the reader with learned discourses or mathematical calculations, and I trust that, although I am compelled to be somewhat brief in my explanation, this portion of the book may be as easily followed as the previous.

We will forget then for a moment the sandy banks of Koutokæino, shrouded in winter darkness, and the strange race dwelling thereon, and direct our gaze and attention to that mysterious celestial display which enhances these parts, so poor in everything, and up-rolls before the simple children of nature a picture before which the most gorgeous sunset of the Tropics must pale.

I hasten, however, at once to correct any misunderstanding which these preliminary words may have caused

in some people's minds. The popular imagination clings strangely to certain *naïve* ideas as to Science. Just as it pictures an astronomer as a man with a large telescope always discovering stars, or a meteorologist as a man whose business it is to foretell the weather, it has as regards this phenomenon fixed its attention only on one point as of interest, *viz.*, *What is the Aurora Borealis?* If any one expects that I will give a categorical answer to this question here he will be disappointed. Should he nevertheless choose to proceed, I venture to say, he will find that there are many important points to be carefully studied before this query can be answered, and that there are features of the phenomenon which are still as closely veiled to the eye as the cause and nature of the aurora itself.

As Science has been unable to give a concise answer to this question the popular mind has attempted to solve the problem of the cause of the Aurora Borealis by various ingenious suggestions. But, although Science must admit its incompetence to give a reply to *the* one demand of the crowd, consolation may be found in the circumstance, that Science can in any case say what the aurora is *not*, and recommend the manufacturers of plausible auroral theories to find more profitable fields for their imagination. In answer to popular hypotheses, modern Science can declare with confidence that the Aurora Borealis is *not* sunshine reflected from the ice-fields of the Polar regions, neither the reflection of sunshine on the surface of the sea, nor the reflection of sunrays in ice crystals suspended in the upper strata of the air, nor the reflection of a molten fluid in the earth's

interior, which, through the thinness of the earth at the poles from rotation, would escape through two gigantic volcanoes, &c., &c.*

Not only can Science reject such childish explanations, whose only merit is the exceedingly simple manner in which the problem is solved, but she may even indicate in what direction every theory as to the nature of the Aurora Borealis must go, for this reason, that it can be stated with confidence, that the Aurora Borealis is of electrical nature and closely related to the terrestrial magnetic forces of the earth. But the masses are not satisfied with this explanation, most probably because their ideas as to electricity and terrestrial magnetism are as obscure as the nature of the aurora itself.

The scientific theories which have been advanced explaining the nature of the Aurora Borealis I shall not refer to here. They are more abstruse than the popular ones, but equally fail to solve the problem satisfactorily in accordance with the observations made. They are generally so untenable that their evolution can only be explained by assuming that the inventors have only studied the phenomenon in southern latitudes, where the aurora never attains the intense form which is its characteristic in the North. Having viewed a few auroræ, and been struck with the wonderful spectacle, a theory has at once been constructed for the entire phenomenon. And what one theorist has observed he has supplemented with such observations alone as have supported his own views—and the problem is solved. It

* The latter theory is not exaggerated or manufactured by me. I have in my possession a letter from a man, evolving the same.

is, however, only a pity that the real aurora is so very different to the theoretical. One might just as well form a theory for explaining the formation of glaciers from seeing an icicle, or construct the grammar of a language from the knowledge of a dozen words.

I am bound to confess that the erroneous views and opinions which prevail among people as to the Aurora Borealis are not wholly invented by them, but to a great extent due to the imaginative writings of their instructors. Popular writers on Science often bring strange things to market. One need only open any one of the popular scientific works in which the Aurora Borealis is described, to find it swarming with inaccuracies, and presenting the most extraordinary illustrations of the same, wholly the production of the draughtsman's imagination. And without any knowledge of the phenomenon one compiler copies from another, the correct with the incorrect, and in the course of time the auroral literature has become so inundated with what may be called "traditional falsehoods," that it would be a herculean task to cleanse these Augean stables.

I trust the reader may not find many such inaccuracies in the following pages. Maybe they will not be so interesting, but they will, at all events, be consistent with facts.

1.—*Principal forms of the Aurora Borealis.*

To give a universal description of the manner in which the Aurora Borealis appears is very difficult, as not only does the geographical position cause variations

in the character of the phenomenon, but even in the same locality there is such a difference in form that no one aurora can be compared to another.

I will attempt briefly to describe the principal features of a strong and a weak aurora, as they may, for instance, be observed in Scandinavia and Scotland.

The sun set some hours ago. The purple glow in the west has disappeared, myriads of stars stud the dark canopy. Far down on the horizon, in north-west and north, lies a faint vague cloud of light, upwards and downwards fading into the sky, a form of the aurora which has, by appearing mostly in southern latitudes, given the Latin name to the phenomenon, viz., *Aurora Borealis* (i.e., the Northern Dawn), a name which does not, in fact, belong to the Latin, as neither the Romans or Greeks had any special denomination for the phenomenon, but which was originated by Gassendi, a Frenchman, in 1621.

Soon after, tiny spots of intense light begin to appear in the luminous cloud, while at times the entire oscillating luminosity disappears from the sky. But still the light is increasing in force, and in a few moments a broad arc of light stretches along the north-western sky, resting both its bases on the horizon in N.E. and W. and whose highest point lies a few degrees above the horizon in N.N.W. Upwards the light is gradually lost in the sky, downwards the intensity is greatest, and the lower edge stands sharply out. Solitary, stronger spots of light, now here, now there, travel, with an unsteady motion, at times right or left through the arc, again to disappear in the cloud. Following the arc

attentively it will be seen to rise gradually, its point of culmination travels upwards, and the distance between the two bases becomes greater and greater. The colour of the light is nearly white, with a weak yellow-green tinge, which is easily discovered by comparing it with the cold, white light of the Milky Way. Suddenly energy and life becomes manifest in the phenomenon. The lower edge of the arc changes in an instant into a small, intense stream of light, which is sharply defined by the dark space below —the "dark segment"—appearing black or faintly violet. Higher up the luminosity gathers into a broad, but fainter arc, running parallel with the other. Only for a moment does the aurora retain this distinct form; stronger waves of light begin to appear in the lower arc, which soon generate groups of intense, short, and perpendicular streamers, reaching the upper arc, which sway right and left, at the same time travelling east or west. Below, the ends, strong in light, cut down into the dark segment, whose sharp curve is thereby broken. Of the upper arc only fragments now remain, while the lower is dissolved into quivering bunches of streamers, which die out one after another as new ones are being lit in their place. They move, here slowly, there quickly, oscillating, apparently to the right or left, but it is impossible to say whether it is really the streamers which move horizontally, or merely the light which passes from streamer to streamer without the latter shifting their position.

But this display is only of short duration, the streamers soon lose their motion and light, and in a few minutes there remain only some pale, diffuse luminosities. Slowly

these now gather, until another arc is formed. It is not so symmetrical, and does not possess the classical rest of the former. Constantly it changes form, position, and intensity until a fresh burst of streamers occurs; in two or three places the light shoots up into bunches of long streamers between which the space is nearly dark; in another second the streamers are isolated in groups, which, like the former, gracefully sway to and fro, their faint points reaching nearly up to the Pole star. The lower ends are broken at various heights, and develop as they move the soft colours of the rainbow. The culminating point in the display has been reached. The streamers vanish one by one, the light pales, and the remnants in the sky again form into a long, low-lying arc. Only for a short time it retains this pronounced form, the edges become obscure, the centre follows, and finally the last faint indications of the aurora sink into the unfathomable darkness of space.

It must not be concluded that all smaller auroræ appear in this form, or that the development is always similar. The greatest variation prevails, as I have said, and the above description is only of a general character. The number of arcs may be two, three, or more (Figs. 1–6), they may be narrow or broad, sink or rise. Often the energy is only capable of producing a luminosity or faint arc, and at other times it develops every one of the above described forms, not once, but perhaps, three, four or half-a-dozen times in a single evening. Sometimes the aurora is lit and again extinguished in the course of a single hour, and at others it remains in the sky, varying in

form, from the first hours of the evening till break of dawn.

I will now attempt to picture one of the most pronounced types of the Aurora Borealis seen in the above-mentioned regions.

It is a lovely evening in spring or autumn. The light is fast fading away in the west, and one star after another comes out of the azure sky. Suddenly a peculiar vibrating luminosity appears high up in N.E., now with a soft purple tinge, and now diffused with long narrow streamers, reaching to the Pole star, or beyond. It is wafted to and fro like a curtain before a light breeze, and its light becomes more and more intense as Night spreads her dark veil over the sky. Suddenly the luminous cloud is furrowed from one end to another by a bunch of streamers, the lower, emerald-green ends of which rest almost on the horizon, while the upper diffuse points, which flame with a purple lustre, reach right up to the Zenith. Streamer oscillates by streamer, more and more follow, and, with a rapidity almost startling, the aurora expands westwards, and shortly after the whole northern sky is a bath of fire. Like a curtain woven of light and colour the streamers hang fairy-like in the air; here and there they form large graceful folds and sway to and fro in wonderful beauty, as if the wind played on the radiating drapery. Red and green play alternately in the lower border of the curtain. For a few minutes longer the marvellous play of light lasts, the varying forms, colours, and motions charm the mind as much as the eye—the forces are then exhausted, the lovely picture grows more and more obscure, and the forms are

dissolved into large soft clouds of light, covering nearly the entire northern half of the heavens.

Down by the horizon there is still, however, great activity, as here a couple of arcs have formed, the constant-changing play of which enchains the spectator during the *entr'acte* between the past and coming scene of the sublime drama which Nature performs on the great stage of heaven: now faint, then strong, soon symmetrical, soon serpent-like, in one moment split into three or four arcs, and again gathering into one, now woven with all the lovely colours of the rainbow, now throwing forth rays and resembling the ornamental pipes in an enormous organ—such is the spectacle I gaze on.

At this moment a narrow, white streamer suddenly leaps up from the horizon in the east, a similar one appears in the west; they both grow rapidly in length, their points meet, and a grand arc spans the sky right above the observer. Simultaneously two long and broad sheafs of streamers, woven of white and red filaments, develop at the bases of the arc. The luminosities on the northern sky again catch fire, and soon after the whole heavens in the north is again ablaze. Quicker and quicker the motions become and intenser the colours, higher and higher the streamers travel, the points approaching the great arc, which is moving slowly southwards. Other groups of streamers form at greater altitudes, in east and west, and the luminous masses cover more and more of the sky. Now a number of white bands suddenly appear overhead, shoot right across the sky from E. to W., and then rush southwards, and vanish. By this time the luminous masses have crossed the Zenith, the points

of the streamers meet in a spot high in the southern sky, while in the east and west the sphere of the streamers moves gradually southwards. A wonderful spectacle is now presented to view. In every direction the whole sky is covered with bunches of streamers, all of which point to this spot—the Magnetic Zenith—and transform the vault of heaven into one gigantic lustrous cupola, the beauty of which no pen can describe, no brush depict. All the marvellous *nuances* of colour of the rainbow contribute to ornament the vault; here is the tender green of the emerald, the grand purple of the ruby, and the charming blue of the sapphire, all blended together in a thousand shades. Here gambol a flock of yellow-green flames, and there mighty pillars rise as if to support the luminous vault, while yonder the sky is covered with a transparent drapery shot with red, behind which dazzling white streamers stand forth. It is the auroral Corona.

A lovelier spectacle is not given the human eye to behold; he who has not seen it cannot form an idea of its magnificence—it defies description.

For a moment the glorious, luminous vault remains thus in majestic beauty, then the supporting arches tremble for a moment, and fall, the faint light-clouds remaining in the southern sky vanish, and the aurora recedes to the northern sky. Here the streaming and play of colour continues for awhile in manifold variation; but the area of the luminosity grows smaller and smaller, and moves steadily downwards to the horizon. A remarkable phenomenon now occurs in the soft luminosities, which still stand high in the northern sky; they appear to leap upwards with the rapidity of lightning, and then

disappear; in several other spots similar clouds come forward and chase each other over the sky. The eye is hardly able to follow their strange gambols. Again the streamers grow in length, the light-clouds cease their play, and once more the streamers approach the Zenith. But now they do not cross it; they remain in majestic rest for a few seconds, and then slowly disappear.

Hour after hour this marvellous display continues in the northern sky, now stronger now fainter, and often it does not cease before the first streaks of dawn appear in the east.

Such great aurôræ as those described above are rare in southern Scandinavia and latitudinal parts, and during my six years' residence in Bergen not one of the 150 auroræ I have observed there has attained such a magnitude. I have, on the other hand, observed two such in Copenhagen, in 1870–72.

What I have stated as to the great variation of the weaker auroræ is, naturally, more applicable still to the stronger and more developed ones, whilst it is also obvious that between the two there are numerous variations.

The illustrations of the auroræ at Bossekop accompanying this work are photographic reproductions made by me of the plates in the famous work, 'Voyages en Scandinavie,' and those from Koutokæino from my own drawings of the auroræ by the same process, as I will presently explain.

In order to give the reader a complete idea—as far as it is possible in words—of the character of the Aurora Borealis, I will quote a description of the phenomenon from the pen of the celebrated Polar *voyageur* and artist,

Weyprecht, from observations made during his wintering in the Arctic regions, near Franz-Josef's Land.

Weyprecht says :—

The stars twinkle in the dark sky, the slightest wind does not stir the air, and a solemn silence reigns over the endless icefields which surround us on all sides: the ruthless Arctic cold has made all nature silent. Even the snow seems to have become ice, the storm and the frost have packed it so that it hardly creaks under the foot of the sailor who paces up and down by the side of the ship, clad to the teeth in furs, shortening the long watch with thoughts of his far-away home, and longing after the sun-bathed shores of the Adriatic.

Only the faint light from the star-studded heavens and the white snow-shroud relieves the darkness now of some months' duration, a little, but not enough to constitute a change to the eye; nowhere is a single form visible, the whole landscape is veiled in the dull monotony of the Arctic night.

But low down in the south stands a faint arc of light. Gradually it gathers strength, and moves slowly upwards. It is perfectly symmetrical, and both its ends reach nearly down to the horizon, striking east and west as it travels higher and higher. There are no streamers in it, the whole being of a continuous luminous mass with a lovely, tender tint of colour: a transparent white with a touch of green. The light of the moon seems yellow by the side of this soft glimmer.

The arc is broad, about three times that of the rainbow, and, being far more clearly defined than the latter,

it stands carved on the dark sky. Still, the flickering light from the stars is not arrested by it.

Higher and higher it travels. In the whole display there is a classical rest strangely impressive; only now and then a wave of light rolls slowly from one end to the other: it begins to get lighter over the ice, and isolated masses may be made out. As yet the arc has not reached the Zenith, but another has meanwhile formed in the south, and moves upwards, followed by others. They all travel upwards; the first has crossed the Zenith, and descends slowly on the northern horizon, losing gradually in intensity. Luminous arcs are now spanning the whole firmament; there are seven in the sky at one time, but their luminous force is small. The further they descend on the northern horizon the fainter they become, until at last they disappear; but some return to where they originated, and then vanish.

Another picture. In some part of the horizon or another lies a close cloud. Its upper edge is illuminated, and from this a band is developed which travels upwards extending east and west, and increasing in intensity. The colour is the same as that of the arcs, but the intensity is greater. In ever-changing play, the band slowly but steadily alters its position and form. The width is considerable, and the intense whitish-green light stands out in magnificent relief on the dark background. The band now falls into manifold curls, which cover, but do not obscure each other, the furthest being clearly discernible through the nearest. Waves of light course constantly through the entire length of the band with an undulating motion, now they run from

right to left, now from left to right; they seem apparently to cross each other as they appear on the nearest or furthest side of a curl.

Now the band uncoils itself to its entire length. It seems almost as if the wind high up in the atmosphere were playing with the broad, flaming pendant, the point of which is lost in the opposite horizon.

AURORA BOREALIS AT BOSSEKOP, JANUARY 6, 1839, 6H. 4M. P.M.

The light becomes steadily more intense, the waves increase in number and velocity, at the upper and lower edge of the band rainbow colours appear, the soft white in the middle is bordered below with a streak of red, above with one of green. Two bands have in the meantime developed from the one, the uppermost of which approaching nearer and nearer to the Zenith, throws forth streamers, which all point to one spot

near the Zenith. The band has now reached this spot, and for a moment a marvellous spectacle may be witnessed. Around the common point of meeting short streamers gambol and waft to and fro, displaying prismatic colours in every edge, shorter and longer streamers alternate, while waves of light whirl with rapid change around the central point. It is the auroral corona we are watching; it appears generally when a band crosses this point.

But after a while the corona gives way, as the band moves beyond, on to the northern sky, where it gradually descends and disappears, or whence it again returns to the south, to repeat its play.

Thus the spectacle is repeated hour after hour, the aurora constantly changing position, form, and intensity. Sometimes it disappears suddenly for an instant, in order to reappear as suddenly in the next, without the observer being able to say where it went or whence it came, only, there it is!

Often the band is of another form, consisting of luminous matter and solitary, close-lying streamers. The luminous waves rapidly following each other produce a greater intensity in each streamer, which imparts to them a constant bobbing motion, while the edges, green and red in colour, dance wave-like up and down under the influence of coursing energy. Often the streamers elongate themselves throughout the whole length of the band; they reach nearly the magnetic zenith, and appear to remain stationary. They are sharply defined, but much fainter than the band itself, and lie some distance from each other. Their colour is

more yellow; it seems as if thousands of gold filaments were shot through the sky.

A lovely veil of transparent light now lies over the starry heavens. The threads of which it is woven stand clearly out on the dark background; its lower *garniture* is a broad, intensely white border shot with the tenderest purple and green, while the innumerable folds and curls sway backwards and forwards in a steady slow motion. At times an auroral haze, violet in colour, also covers parts of the sky.

Again another picture. Throughout the dark Polar day, auroral bands of every form have drifted over the sky. It is now eight o'clock in the evening. At present only a few solitary bunches of streamers remain, but in the south, just above the horizon, lies a faint band, so faint that it is hardly noticed.

Suddenly the band rises, and, striking east and west, waves of light begin to course from one end to another, while long, solitary streamers shoot up towards the Zenith. For a moment it remains stationary, then it suddenly leaps into activity. From east to west the luminous waves begin to course rapidly throughout the band; the borders become intensely purple or green, and bob up and down. Quicker and quicker the streamers shoot upwards, and become shorter as the band travels slowly towards the Zenith. More and more rapidly waves follow upon waves, cross each other, leap over each other, while the streamers race madly to reach the magnetic zenith: they are no longer solitary streamers, but whole bunches. At this moment they reach that point towards which they were all striving, and now they begin to bob up and down on all sides, in north, south, east and west. Do the

streamers strike upwards or downwards? Who can say? Around the centre is a sea of flames; are they red, white or green? Who can tell? it partakes of all three colours at once. The streamers reach nearly from the Zenith down to the horizon: the whole sky is on fire. The band has become an arc, which, passing through the Zenith, rests on both horizons; it has become a river of flaming fire, on which the light-waves course with terrible velocity. Nature displays a pyrotechnic spectacle the grandeur and magnificence of which the most daring imagination cannot picture. We listen involuntarily—such a display seems impossible without *sound*, —but a breathless silence reigns, not the faintest sound falls on the ear.

It has cleared above the ice, its jagged peaks are sharply delineated, while the outline of the white ice-field is carved on the dark horizon. The lofty icebergs cast shadows on the white snow. Take a book in the hand, and you can read it.

But now the light fades fast. With the same startling, mysterious rapidity with which it came, it is gone. Only yonder, in the northern sky, a solitary band still remains; slowly the waves roll through it. Night has again cast her veil of darkness over the ice.

Such is the Aurora Borealis in its utmost grandeur. No colour, no brush can picture its magnificence, no words describe its sublime beauty.

And below we wretched Children of Man stand and boast of our knowledge and our progress, conceited by possessing the mind by which we have defrauded Nature of some of her secrets; there we stand gazing at that

great problem which Nature writes in flaming cypher on the dark winter sky; there we stand, lost in wonder, obliged to confess—that we really know nothing!

2.—*Classification of Forms.*

I will now proceed to describe more closely the principal individual forms or types of the Aurora Borealis, which have certainly been referred to previously, but merely cursorily. It should, however, be remembered that my classification is chiefly theoretical, because the Aurora Borealis does not respect any such arrangement, for this reason, that there exists such a number of transitory forms between each type that one kind may claim to belong equally to two categories, or to neither. The conditions may be compared to the classification of clouds. Every scientific observer of the clouds will have made the discovery that the six classes, or more, to which these are referred are insufficient, as he may often observe variations which cannot, with certainty, be said to belong to either of these classes, but which are nevertheless defined.

Auroral Arcs.—The Aurora Borealis appears in the form of arcs in southern Scandinavia, England, &c. They appear generally in the northern part of the horizon, more or less above it, but the higher the arc stands the further its bases extend east or west. The width varies from half a degree or less—the diameter of the disk of the full moon is half a degree—to one, two, three or more degrees. When the width is smallest the light is, as a rule, most intense, and both edges sharply

it is not darker than any other part of the sky, but it may at times appear perfectly black, while at others

PHASES OF AN AURORAL ARC.

FIG. 1.—DECEMBER 1, 1878, 7H. 20M.

FIG. 2.—AT 7H. 33M.

FIG. 3.—AT 7H. 57M.

it is violet in colour or faintly brown. It is mostly observed in southern latitudes, and is seldom prominent in those parts where the auroræ are most frequent and

cover great parts of the sky. The segment is not formed of clouds, although, of course, a cloud-bank *may* lie so that

PHASES OF AN AURORAL ARC.

FIG. 4.—AT 7H. 59M. 30S.

FIG. 5.—AT 8H. 10M.

FIG. 6.—AT 9H. 4M.

it seems to form it, as there are often opportunities of seeing the stars clearly in it.

The explanations of this phenomenon are several.

Thus some scientists consider that it is simply an optical illusion produced by the contrast between the dark sky and the brilliant arc above, while others maintain that there is a specific cause for the phenomenon. The latter hold that this is proved by the peculiar colours seen at times, although these may be due to the effects of contrast too, and assert that various observers have seen the segment *before* the arc appeared. Even as regards the latter point there may be some misconception; but, however that may be, the phenomenon is one which must be referred to the future for solution.

Auroral Bands.—This form of the aurora is in aspect and appearance, but hardly in reality, different from the common arcs, as the difference is in all probability caused simply by the band being nearer to the observer, and lying, therefore, higher in the sky, it is far more impressive in character. The aurora, seen and described by one observer as a *band*, may by another, from a more southern point, be pronounced an *arc*.

The auroral band is oftenest seen in those parts of the globe which are considered to be the true home of the Aurora Borealis, but seldom, or hardly ever, in southern latitudes. What is chiefly characteristic of the band in opposition to the arc, although no sharp line of distinction can be drawn here either, is its great height above the horizon, but at what elevation it ceases to be band and becomes arc is naturally an arbitrary determination. The band, as well as the arc, may consist of equi-luminous matter, of streamers, and of so-called luminous clouds, and it is, to a higher degree than is the case with the arc, subject to the most violent changes of

position, form, and motion. Particularly when the band consists of streamers it displays the richest variations and greatest beauty, the folds of the streaming drapery, the prismatic play of colour, and the light-waves, which with marvellous rapidity course through the graceful, undulating rays, forming a spectacle of light, colour,

AURORA BOREALIS AT BOSSEKOP, JANUARY 21, 1839, 6H. 0M. P.M.

and form which makes this variety of the Aurora Borealis the most charming of all.

In the illustrations of the auroræ at Bossekop, and partly also in those at Koutokæino, it is the auroral band which is delineated.

Sometimes several bands appear simultaneously at various heights. To a distant, southern observer these bands will—provided they stand above *his* horizon—probably cover each other, appearing as a single, normal

arc, but a nearer observer will see it as two, three or more arcs in the northern sky.

The perspective fundamental form of the arc, and also the band, may, in my opinion, be explained by the aurora forming one or several rings, or fragments of such, which, with the magnetic pole as centre, or, more correctly, with a point in the magnetic axis of the earth, viz., the straight line between the two magnetic poles, lie at a certain height above the earth's surface. On account of the great circumference of the earth, in proportion to the height of the aurora, only a small portion of such a ring would be visible at one time, and each observer only see his own portion, the situation of which in relation to *his* horizon and the Zenith will depend on *his* position in relation to the auroral ring.

This may be illustrated in the following manner. On every superior globe a small metal ring may be found above the North Pole, showing the twenty-four hours. If we assume this ring to be a little larger, and drawn a little further down, as indicated in Fig. 7, we shall obtain a clear and somewhat correct idea of the conditions relating to the auroral ring. If we now imagine that a microscopic insect be crawling up the globe, along the line *a e*, it will at *a* see nothing of the ring, as it will be completely hidden by the convexity of the globe, but on reaching *b* it just begins to catch a glimpse of the ring above its horizon. At *c* it will see a small portion of the ring as an arc, whose culminating point lies in the direction of the globe's north, while at *d* the arc will appear high above the horizon and its bases further south. When the insect is half-way between

d and *e* it will see the ring just above its head, and, when it proceeds further north still, it will see the ring in the south.

It should, however, be remembered that the auroral ring does not have for its centre the geographical pole or a point in the earth's axis, but, in the main, a point in the magnetic axis; and further, that the ring is not always a single one, but consists generally of several, each having its centre in various points of the magnetic axis, and that the ring is seldom perfect, but generally

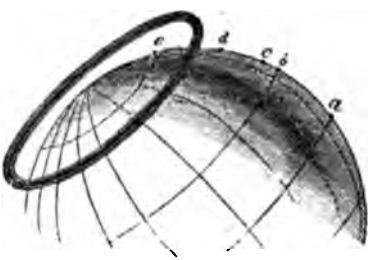


FIG. 7.

broken, and with many deviatons from a symmetrical configuration.

The ring, moreover, moves south or northwards, a circumstance which will, to an observer *standing in one spot*, account for the variations in the appearance of the aurora which I have indicated above under the supposition of a fixed auroral ring and a travelling observer.

If it, finally, be borne in mind that my object in drawing the above comparison with the globe was only intended as demonstrating a purely typical basis—which may, through a number of unknown causes, be greatly

modified,—I maintain that we shall find in this illustration a means of explaining the auroral arc and its different appearance and position in various localities and with alternating auroræ.

It might from the foregoing be concluded that a person standing at the magnetic pole, or close to it, would see the Aurora Borealis as a perfectly symmetrical ring running round the entire sky above the horizon. But this would not be the case. The height of the Aurora Borealis above the earth's crust is—as I shall presently show—even if estimated at several hundred miles, so small compared to the dimensions of the earth, that nowhere, whether inside or outside the ring, can it be seen complete. Everywhere only a comparatively small portion of an arc will be seen.

Auroral Streamers.—This form of the Aurora Borealis is, next after the arc, that best known in southern Scandinavia, Scotland, &c. The streamers, too, embrace a number of varieties, which have only one peculiarity in common, viz., that the direction is very nearly vertical, and that the length is always greater than the width. The length differs greatly, from 2° and 3° to 30° and 40° or more. The width is very difficult to estimate, on account of the constant motion; a single streamer thus may form only a slender thread of light, while others may have a width of from 10′ to 1°, or more. Short streamers form often, as I have mentioned above, bands or arcs. The long streamers gather generally in bunches, which may either remain isolated, or, particularly when the aurora has previously formed an arc, stand parallel, in such a manner that the lower, intensest, ends nearly follow the

track of the former arc. Bunches of streamers, standing high in the sky, are often fan-shaped, the broadest part pointing downwards. The intensest streamers have very clearly defined edges, but from these there are all sorts of variations down to the streak of light hardly visible. At the side of, and between very intense and defined streamers, the sky seems, by the contrast, unusually dark, and this may, perhaps, explain the *black* streamers which some observers claim to have seen.

The points of the streamers are usually faint and with no sharp line of demarcation. The stars shine through the streamers as through all other forms of the aurora, and it may, indeed, be a matter of doubt whether the strength of light of the aurora is ever great enough to outshine a bright star. The arc and band composed of streamers form often the basis for a row of streamers or colonnades, and in such a case it is difficult to decide whether to call the form arc, band, or streamers.

The motion of the streamers is twofold. First, longitudinally, as they strike upwards or downwards; and secondly, laterally, as they travel parallel either to the left or right. Sometimes this motion is slow, sometimes very quick, and particularly in the latter case the observer obtains the impression that the colonnade of streamers is furrowed transversely by waves of energy following in rapid succession, under the influence of which the streamers momentarily flare up. If this be the case, or the streamers really move, it is impossible to tell.

The longitudinal course of the streamers is not apparently only, but in reality, very nearly vertical, as

several facts prove that they point in the same direction as the magnetic inclination needle, i.e., that they point for southern Scandinavia to a spot in the sky situated about 70° above the horizon, and 20° S.S.E. from the Zenith. It is this point which is called *the Magnetic Zenith.* In regions nearer the magnetic pole, where the magnetic inclination is greater, the streamers stand more perpendicularly than in more southern latitudes, where they form a smaller angle with the surface of the earth.

Some students, as for instance, Baron Nordenskiöld, have advanced the theory that the streamers do not occupy this position, but lie more parallel with the earth; and, indeed, when observing an apparently perpendicular streamer in the north, it may in reality form any angle with the horizon, and still seem to the eye to stand perpendicular. But from various circumstances it is clear that the direction of the streamers is, as I have stated above, viz., parallel with the inclination needle. This is, in fact, demonstrated not only by the streamers high in the sky, which form the upper part of the corona, but also by those which, under intense auroræ, stand either in the east or west, and which are then seen "*from the side*," so to speak, i.e., they stand very nearly perpendicularly, as indicated to all appearances by the streamers seen to the north "*in front.*"

The Auroral Corona.—This form of the Aurora Borealis, which generally indicates, at all events in southern latitudes, the culmination of the aurora as regards splendour, colour, and development, is produced by the streamers shooting from every part of the sky towards a common

point, viz, the magnetic zenith. With this point as centre they seem to radiate in every direction; some are very long, others short, while some form rays or bands one above the other. The heaven thereby assumes the appearance of a huge cupola, or tent of fire. In reality the streamers are all parallel; their appearance of radiating in all directions from a central point with various angles being due to perspective causes, viz., by the points of the streamers being further distant than the bases. It is the same perspective peculiarity which causes the lamps in a street or the trees in an avenue to appear to meet in the distance.

The centre of the corona is sometimes dark, that is to say, the sky is seen between the streamers, at other times the central part is filled with luminous matter.

It is not only the streamers which contribute to form the corona; on the contrary all the forms of the aurora lend their beauty to produce this magnificent display. If to this is added that the Aurora Borealis in such moments develops its greatest strength, richest colour, and most intense light, it will be understood that the corona is that form of the phenomenon which possesses the greatest magnificence and most striking beauty.

The corona is, however, not always equally grand. The form is there, but the motion and the light is small, the richness of colour absent. At times the corona is imperfect too, only its southern or northern half being present, whilst at others faint outlines only reveal its main form.

The corona is generally formed by the aurora travelling gradually from the north higher and higher,

crossing the Zenith and reaching the magnetic zenith. Quick as lightning streamers break forth at the same moment on the southern side of the magnetic zenith, and as the aurora travels further and further southwards, the corona becomes more and more complete. In northern regions, where the aurora frequently appears high in the sky, in a northerly or southerly direction, there is often an opportunity of seeing this form of the phenomenon, when a band of streamers passes the magnetic zenith in its course north or southwards. It is, however, not always that the aurora's passing of the Zenith has the effect of producing the corona; it is seldom the case when a band constituted of diffuse luminous matter passes this point. It is, in fact, the streamers which create the corona.

The grandest coronæ last generally but a short time, but they often re-form several times during the same aurora. Less developed ones may last longer, a quarter of an hour perhaps, and even an hour.

If it be borne in mind that the course of the auroral streamers is identical with that of the magnetic inclination needle, it is easy to perceive the origin of the ordinary radiating aurora as well as the corona.

If we assume, in conformity with what I have already demonstrated, that the streamers, which form an angle with the horizon of 70°, are collected in a big ring around the magnetic pole, and that the spectator stands south of the same—as shown in Fig. 8—he will see a normal, radiating aurora, A. The ends of the streamers form an elongated arc on the horizon, its highest point lying in N.N.W. If the radiating ring moves, parallel

with itself, further south, so that at B it lies between the observer and *his* magnetic zenith, Z, he will see the auroral corona. The whole sky, or in any case its highest portion, is covered with streamers, all of which seem to converge towards Z. A still further advance southwards will cause the streamers to appear like a band or an arc on the southern sky.

Auroral Clouds.—When a radiating aurora or a part

AURORA BOREALIS AT KOUTOKÆINO, OCTOBER 6, 1882, 7H. 57M. P.M.

thereof, becomes less active the streamers lose in strength; the edges become indistinct, the length decreases, but the width increases to such an extent that, finally, luminous clouds of various sizes are formed. These so-called auroral clouds have no distinct or characteristic form. Their outlines are rounded and less intense than the central part, while their force of light is generally very small. They are either spread irregularly over the greater part of the sky, or, when the aurora has just

a peculiar form or motion, which must, however, not be confounded with that which seems to furrow the radiating colonnades, but which may most aptly be compared to the wave-like motion of a cornfield under gusts of wind.

Faint masses of luminous matter, either in the form of auroral clouds or streamers, or fragments of either, suddenly appear on the sky, and rush with a wave-like flaming, and great rapidity upwards, or, it seems, as if a quivering, energetic force travels at intervals rapidly up the sky, causing the surrounding luminosities momentarily to flare up with a faint lustre. This motion is chiefly noticed under and after great auroræ. It is generally only apparent high above the horizon, and affects as a rule large portions of the aurora. Either the motion arises in already existing forms of light, or extends far beyond the limits which an extinct aurora occupied.

With this I have described the forms most characteristic of the Aurora Borealis, and I intend in the following only to refer briefly to some features of the phenomenon, which are of particular interest.

The fundamental colour of the Aurora Borealis is white with a pale green or greenish-yellow tinge. If it be compared with that of the moonlight, which we consider white, the latter appears yellowish by its side. When, however, compared with the absolute white light of the Milky Way the green tinge in the auroral light is clearly visible. Nearly in all small, and in a great many large auroræ too, this is the only colour.

When the Aurora Borealis becomes more intense, red

and green also appear, which colours may also be seen in the lower edge of low-lying, radiating arcs. They appear then to be mixed, the constant oscillation preventing the observer from ascertaining the true limits of each and their relation. In more elevated arcs or bands it may be clearly seen that the red colour belongs to the lower edge of the colonnade of streamers, and higher up changes, through white, into green. The edges of the

AURORA BOREALIS AT KRISTIANSUND, OCTOBER 6, 1882, 9H. 30M. P.M.

streamers may also show these colours, particularly when the activity is great, the preceding edge is then red, the following green. The red colour appears sometimes alone, without being accompanied by the green, colouring large and generally high-lying portions of the aurora, a circumstance which becomes most manifest when the aurorae are very vivid. At such times large patches of the sky are covered with a continuous layer of violet or blood-red luminous matter.

Some ten or twelve years ago several such blood-red auroræ were seen in North and Central Europe, which by some were believed to prognosticate wars, by others to be the reflection of great conflagrations, an explanation rendered greatly plausible by the disturbed state of Europe at the time.

Under very intense auroræ the red and green assume the loveliest *nuances*, and other colours of the spectrum may also appear, although seldom.

With regard to the spectrum of the Aurora Borealis there is at present but little to be said with certainty, as the observations made hitherto have not given us the slightest clue to the nature of the light the aurora emits.

The first research with the spectrum of the aurora was effected by the Swedish physicist Professor Ångström, in 1867. He found that the spectrum consisted principally of a yellow line, lying to the left of a well-known calcium line, in the yellow and a little towards the green part of the spectrum. Besides this one, Ångström observed three others near the green part, but they were only faint streaks. Later students have discovered several more lines. The yellow-green line always appears even with faint auroræ, and is in any case always the most prominent, but in addition lines or bands may be seen in red, green, blue, and violet. The latter are, however, always faint, and are often absent.

The difference between the spectra seen by various observers, and the difficulty of identifying the lines noticed, coupled with certain other circumstances, have greatly delayed the definite analysis of the light of the Aurora Borealis. It has also, on the other hand, been

found impossible to produce artificially a spectrum similar to that of the aurora, and neither has any one been able to demonstrate that any of the auroral lines coincide with the lines of known terrestrial elements, although some of them lie near those of certain gases and iron.

The spectral analysis, which has been so fruitful in other departments of science, has thus up to the present proved valueless for the purpose of ascertaining the nature of the Aurora Borealis.

3.—*My Observations at Koutokæino.*

I will now proceed to give an account of the character and appearance of the Aurora Borealis at Koutokæino. The scientific treatment of my researches are, at the time of writing this work, not finished, and as they would neither be in their place here I purpose merely to give some condensed particulars which may supplement the above.

The Aurora Borealis is without exaggeration an every day occurrence, and an evening or night without it would be as remarkable an event as its appearance at the Equator. There was, at all events, during my sojourn not a single clear evening when it was absent. The weather was, however, during a great part of the winter very unfavourable, owing to heavy masses of clouds, which prevented observations, a circumstance quite exceptional in these parts. But in spite of this drawback I am happy to say I gathered a fairly copious material.

The appearance of the auroræ possessed here, as in all high latitudes, many varieties. Often they were confined

to insignificant and faint arc-phenomena low in the north, just like those observed in southern Scandinavia, but sometimes they attained a magnificence which defies description. On several occasions the whole sky was covered with auroræ.

In one respect in particular my sojourn at Koutokæino was very instructive, viz., with regard to the understanding of the true shape and position, and the changes to

AURORA BOREALIS AT KOUTOKÆINO, OCTOBER 15, 1882, 5H. 30M. P.M.

which the aurora is apparently subjected when altering its elevation above the horizon. Partly through the frequency of the aurora, and partly by its appearance now in the north, now in the south, and now in the Zenith, there were excellent opportunities of studying the modifications which the form suffered as it changed its position in relation to the observer.

From this I came to the conclusion that the great many different forms referred to might certainly be reduced

to a few fundamental ones. In most instances the aurora forms belts or zones, which stretch across the earth in the direction of the magnetic east-west, which zones are formed by a conglomeration of thin sheets of luminous matter ranged one behind the other, their direction being parallel with the inclination needle. The luminous matter in these sheets is either even, diffuse, or divided into streamers.

Everything now depends on the position of the observer in relation to such a zone in order that it may appear in one form or the other. If he be very far from the aurora he will see an arc, diffuse or radiating, according to the nature of the luminous matter. If he approaches he will most probably see several distinct arcs, the phenomenon gathering more force and the colours more life; and when still nearer, the aurora will appear as a band, and, if the luminous matter be radiating and passes the magnetic zenith of the observer, he will behold the auroral corona.

It is, however, only in the main that although, as a rule, the course of the Aurora Borealis is east-west, there are many deviations from this direction, particularly when the luminous matter is radiating. This may be best noticed with the radiating bands at a great elevation. In addition to the folds which the luminous sheets continually develop, the bands themselves may, at all events for some moments, occupy almost any position, and garland the sky in the most fantastic and weird manner.

I have seen bands run from north to south, sometimes coiled up in a spiral form, and at others even forming a circle, almost perfect, around the entire sky, its centre

being Zenith, and its altitude above the horizon about thirty degrees.

The great deviations of these luminous zones from their true course are the cause of the many irregularities which are so often observed in the arcs, as, for instance, their un-

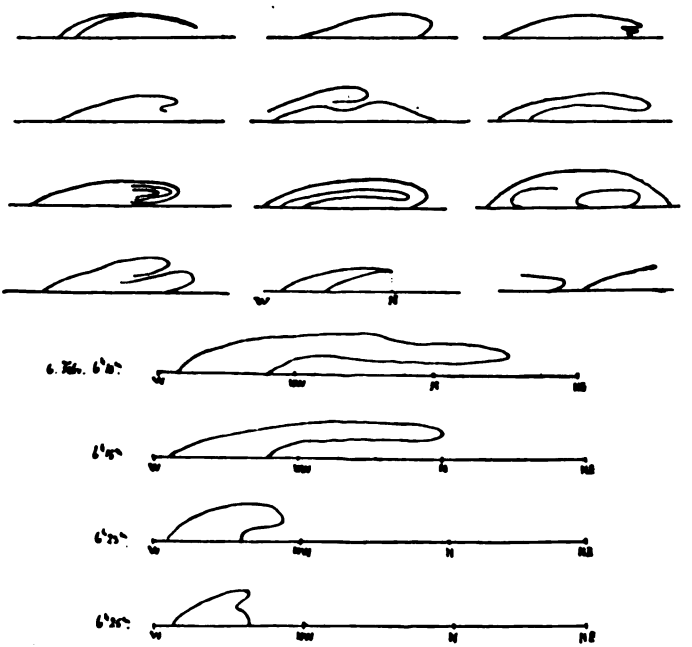


Fig. 9.

symmetrical position in relation to the magnetic meridian, their irregular form, their elliptical curve at the bases, &c. I have in Fig. 9 illustrated the fundamental lines of some of the remarkable forms which I observed in low-lying arcs during my sojourn in Lapland.

The sling or bow-like forms were particularly strange and very frequent. These arise from two low arcs being connected and continuous in their eastern ends a little above the horizon. As an illustration of this type the sixth, eighth, and the four last small diagrams on Fig. 9 may serve. It is also seen on several of my illustrations of the Aurora Borealis. It may almost be accepted as a rule, that the connections always take place in the *eastern* ends and never in the *western*, and also that the former are richer in irregularities, curves, &c., than the latter.

Another peculiarity is, that these bow-shaped arcs nearly always travel westwards, and thus, provided they last long enough, disappear below the horizon. The last drawings on Fig. 9 furnish a good illustration of this phenomenon. Even when the corresponding forms stand high in the sky, in the shape of bands or coronæ, the entire auroral display moves in a westerly direction.

Of quite a different kind to the above-described curves are the soft, elliptical curves of the ends of certain, particularly more elevated arcs. These latter are, however due to perspective causes, whilst the former indicate decided deviations from the true course.

The study of the auroral corona is particularly instructive. When a band of streamers moves towards the magnetic zenith the streamers appear to become shorter and shorter, owing to the circumstance that they are observed under an angle more and more acute, and when the band passes the magnetic zenith only its lower edge is seen, which then appears as a curved and folded line of light. The observer may then see that each

individual colonnade of streamers is very narrow, but generally the band consists of several, sometimes of a great number, of such, standing behind each other, and almost parallel. If the latter peculiarity be manifest the corona will assume a particularly grand and perfect form, which, combined with the incessant motion and change in form and colour, renders the spectacle one of the most sublime revealed to the human eye.

To the above-described fundamental form of the Aurora Borealis, which runs in zones consisting of diffuse or radiating luminous sheets in the direction of the inclination needle, nearly all others may be referred. The isolated streamer or bunches of streamers are nothing but imperfect colonnades of streamers, the luminous clouds being, so to speak, remnants of radiating auroræ, which seem, indeed, also to consist of sheets in the direction of the inclination needle.

The large red patches of aurora which are observed in the sky under very intense displays I never observed during my stay at Koutokæino; I will, therefore, not venture to explain this phenomenon, and say whether the layer of light really forms a continuous veil running parallel with the earth's surface, or whether, even here, the direction is the same as that of other forms of the aurora.

I was for a long time in doubt how the form denominated "auroral waves" was to be interpreted. This phase appears almost without exception—as is the case with the true auroral "clouds"—not till the later hours of the night, about midnight or a little later, and generally follows extensive and brilliant auroræ. One might almost call them "*pulsating* auroral clouds," as there is

not only an extreme similarity between the two forms, but their relation is so close that the difference between them is merely that one is quiet, or, at all events, shows only limited changes or motions, whilst the other has a motion so quick and energetic that it is hardly possible to form any opinion of the real nature and laws of this phenomenon.

Sometimes this form of the aurora may cover the entire

AURORAL CORONA AT KOUTOKÆINO, NOVEMBER 18, 1882, 9H. 50M. P.M.

sky, and for hours resemble a bath of liquid fire under a gentle breeze. A close observance and study of this phenomenon has finally convinced me, that this form of the Aurora Borealis is also produced by luminous sheets pointing in the direction of the inclination needle. I feel convinced that the apparent wave-like motion is due to three causes, viz., (1) the brief, often only momentary, duration of the luminosity; (2) the quick, licking,

bobbing motion up or down in the direction of the plane; and (3) to their marvellously swift movements horizontally, parallel with the earth's surface.

The true auroral clouds—apart from the diffuse luminous masses which are seen under nearly every phase of the aurora, and are also called auroral "clouds"—forming as the auroral waves the closing moments of great auroræ, often so deceptively resemble the clouds known as cirrocumuli that it is almost impossible to say, particularly in strong moonlight, whether they are one or the other.

The sky in these northern latitudes is, even when free from true auroræ, not so dark as in southern countries. It is rather grey than bluish-black. Probably, a kind of auroral "veil" always covers it. Sometimes this may, indeed, be observed when rents are made in it; the dark sky is then seen between them.

I had often an opportunity of confirming in the most striking manner the theory held by some *savants*, that the Aurora Borealis affects the state of the clouds. The sky might be ever so clear, but after an unusually vivid burst of aurora in the Zenith it always became at once covered with clouds. These dispersed, however, generally immediately afterwards.

Although the Aurora Borealis often extended over the entire sky or appeared in the south, its principal arena was the northern sky. The zone in which the aurora appears most frequently lay therefore, at all events in the winter 1882-83, north of Koutokæino. The same was, according to the information I obtained at Bossekop, the case there.

With regard to the colours of the Aurora Borealis I have already said sufficient. The red colour in the lower edge of arcs and bands often assumes remarkable *nuances*, such as crimson, purple, pink, red-ochre, and violet. When the movements are very rapid the bases of the streaming colonnades form entire sheets, deep red in colour, which lick the sky with great intensity downwards.

As regards the strength of light of the Aurora Borealis, greatly exaggerated notions are entertained in southern countries. Thus, that the aurora should compensate for the loss of the sun is a mere fable, while the belief prevalent, that it greatly assists the dwellers in these parts in the dark season, on their journeys or in their work, is a gross exaggeration. Generally, the aggregate amount of light emitted by the Aurora Borealis is so small that its contribution to lighten the darkness is almost *nil*, while it must be of an unusual brilliancy to be even *seen* when the moon is full and the sky clear. For a few moments certainly the light may be very intense, and cast an unusual brightness over the landscape, but these intervals of luminosity are so brief that the light emitted is of no practical value whatever to the inhabitants of the Polar regions. The very greatest amount of light which the Aurora Borealis emitted, or which, in any case, I was able to ascertain during my entire sojourn in Lapland, may be compared to that of the moon two days and a half after full when 25° above the horizon and the sky is clear. At such moments I was able to read without difficulty print of the size indicated below. Rarely,

From this day, we date the total fall

however, the Aurora Borealis attains this degree of brightness.

Every attempt I made to photograph the Aurora Borealis failed. The result was the same at the stations at Bossekop and Sodankylä. In spite of using the most sensitive dry plates, and exposing them from four to seven minutes, I did not succeed in obtaining even the very faintest trace of a negative.

AURORA BOREALIS AT KOUTOKÆINO, FEBRUARY 4, 1883, 5H. 55M. PM.

The reason is, I am convinced, the small strength of light, and its limited chemical action. The illustrations, therefore, of the Aurora Borealis at Koutokæino accompanying this work are, as stated, photographic reproductions of my own drawings.

Before concluding this part I cannot forego the pleasure of reproducing by the camera, as a curiosity, a facsimile of one of the first drawings which we possess of the Aurora Borealis. It is taken from one of the

engravings on copper in a work published in Copenhagen, in 1767, by one Knud Leem, entitled 'Beskrivelse

FACSIMILE OF AN OLD DRAWING OF LAPPS HUNTING BY THE AURORA BOREALIS.

over Finmarkens Lapper' (An account of the Lapps of Finmarken). The text accompanying the engraving is very curious, viz.: "When a Lapp goes fox-shooting,

he begins by burying bits of meat in several places in the snow. The fox, smelling the meat, approaches, and, as it digs in the snow to get at it, the Lapp, who lies in wait, salutes him with a bullet. This kind of sport (!) the Lapps pursue at night when the moon is up, or when there is an Aurora Borealis, which in that country, during the winter nights when the air is clear, is as intense as if the sky were on fire, and which, in a manner, shines like the most brilliant moonlight."

This quotation appears to me necessary to understand the subject of the drawing.

4.—*The Geographical Extension of the Aurora Borealis.*

The Aurora Borealis becomes rarer and less brilliant the nearer we approach the Equator, and again it becomes less frequent and poorer when a certain line around the Pole is crossed; but the regions where the phenomenon appears most frequently and attains its greatest development is not everywhere equally far from either the geographical or magnetic North Pole of the earth.

This in, in principle, our present knowledge of the laws which govern the frequency and occurrence of the Aurora Borealis.

The first researches on these points are due to Professor H. Fritz, of Zürich, as well as the merit of having constructed a map which shows graphically the frequency of the Aurora Borealis in the various parts of the northern hemisphere. In the same manner as is done in respect of

times denominated the Aurora Borealis, i.e., fissures in the heavens.

If we possessed a series of observations of the Aurora Borealis, extending over many years, from a great number of places, obtained by a common method, similar to those we possess of the meteorological and magnetic phenomena, the yearly averages of these would suffice to give us a conception of the various geographical frequencies of the Aurora Borealis. This is, however, far from being the case; from most places we have but fragmentary and very unsatisfactory returns of auroral observations. There is also another drawback to such, viz., that the Aurora Borealis is, as regards occurrence, a periodical phenomenon, the frequency of which, at all events in lower latitudes, is subject to great variations, so that a series of observations for a year or two cannot give any reliable data as to the yearly average number of auroræ in a certain spot.

Fritz has attempted to avoid this difficulty in the following manner.

If we call the yearly average frequency m in a certain spot A, the total sum c (4834) of all auroræ seen in Central Europe from 46° to 55° lat. N. during the 172 years from 1700 to 1872 which are entered in Fritz's great catalogue of auroræ, the total of the auroræ seen, during a certain period at A, a, and the total of the auroræ recorded in Central Europe during the same period e, the yearly average frequency m for A is obtained by the following formula:

$$m = \frac{c}{172} \cdot \frac{a}{e} = 28 \cdot \frac{a}{e}$$

and thus we have, for example, for Christiania :

1837–54: ($a=529$, $e=581$), $m-25\cdot5$
1855–70: ($a=436$, $e=568$), $m=21\cdot9$
1837–70: ($a=965$, $e=1149$), $m=23\cdot7$

As may be seen, these three values differ somewhat, and neither can an *exact* agreement between the averages of *different* places be expected. Even for places close to each other the deviations are sometimes very great, which is due partly to the different methods of observation followed by the observers, and partly to the meagre records of auroræ. Observations extending over a considerable number of years give, I must say, fairly corresponding results.

If now the values obtained for m be entered on a chart, and the points showing equal figures as to frequency connected with lines, we have the curve system shown in Fig. 10. Here are, besides the maximum zone, drawn lines for averagely 100, 30, 10, 5, 1, and 0·1 auroræ per annum.

Of these lines we will follow in detail some of the most interesting.

The line for $m=0\cdot1$—i.e., for places where, during ten years, only a single aurora is observed—runs through the southern part of Spain, north of Sicily and the southern border of the Black Sea, south of the lake Baikal to the Kuriles, then north of the Sandwich Islands, through the southern part of California and Mexico, and finally, over Cuba and Madeira. In latitudes south of this line auroræ are very rarely seen; in 502 auroræ were, however, seen at Edessa, in 1097–98 in Syria, in 1117 in

Palestine, in 1621 in Aleppo, in 1837 in Teneriffe, in 1848 in Asia Minor, in 1859 in the Atlantic Ocean as far as 14° lat. N., in 1870 in Asia Minor, and in 1872 in India and parts of North Africa.

In Asia all the curves lie further north than in Europe and America; thus in the southern parts of Asia auroræ are very rare. Even for Pekin (40° N.) there are very few auroral records; during the great maximum period about 1871 no aurora is recorded in the meteorological observations of the Pekin Observatory (1868–74). At Nicolayewsk, on the Amoor (53° N.), only a single aurora was observed during the maximum period 1870–74. On the Sandwich Islands large and very extended auroræ only are seen. In America, on the other hand, the line 0·1 goes down to 20° lat.

The line $m=100$ runs from the Hebrides, over the Shetlands, Trondhjem, Vardö, Novaya Zemlya, to the mouth of the Lena, crossing the Behring Strait under the Polar Circle. Thence through North America, across Kotzebue Sound and Fort Simpson, through the southern part of Hudson Bay, and a little north of Newfoundland.

The line along which the Aurora Borealis is most frequent—the maximum zone—runs from Point Barrow, over the Great Bear Lake, to Hudson Bay, crossing it close to the 60th degree, over Nain, on the coast of Labrador, south of Cape Farewell, in Greenland, between Iceland and the Faroe Islands, across the Lofodden Islands, the North Cape, the northern point of Novaya Zemlya, Cape Cheljuskin, and south of Wrangel Land. In the parts crossed by this line the Aurora

Borealis is during the dark season a phenomenon of everyday occurrence.

Inside this line, i.e., towards the Pole, the Aurora Borealis again decreases in frequency, probably more rapidly than outside it, although it is hardly possible that the Aurora Borealis is *completely* absent in any spot within this line, as is the case at the Equator.

One of the most remarkable features of the curve system is its irregular position in relation to both the geographical and magnetic North Pole, the latter being on the chart indicated by M. P. The maximum zone encircles both, but does not lie symmetrical to either, in fact, the central point of the system seems to lie nearly exactly between the two. It is partly this which causes the system to fall comparatively further south in America than in Europe, and, more particularly, than in Asia.

If we follow the meridians 90° and 270° long. E. through Asia and America, we obtain for every fifth degree of latitude approximately the following values for m:—

	Lat. N.	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°
m.	Asia	0	0	0	0	0	0·1	0·3	0·9	4	8	30	100	max.
	America	0·1	0·5	1	4	7	20	40	100	max.				

If we, on the other hand, examine under what degree of latitude each of the curves of the chart crosses the meridians 90° and 270° we have:

	m.	0·1	1	5	10	30	100	max.
Lat. N.	Asia	47	56	62	66	70	74	78°
	America	21	31	37	43	48	55	60°

From these comparative tables the difference which

exists as regards the frequency of the Aurora Borealis. between America and Asia, will be apparent.

As to the luminous phenomenon which is observed in the southern hemisphere under the name of Southern Lights, *Aurora Australis*, and which is, no doubt, in every respect related to the Aurora Borealis, we possess so few data that it would be impossible to frame a similar chart of its geographical extension for this half of the globe. According, however, to the few records we possess *m* is, according to Fritz, as follows for the undermentioned towns: Hobart Town (43° S.) 6, Melbourne (38°) 15, Auckland Islands (50°) 10. The places nearest the Equator where this light has been observed are: Cuzco (12° S), in 1744, Rio Janeiro (23°) in 1783, Africa, to the 28°, 1870-72, and Mauritius (21°) 1870–72.

Although it must be admitted that the material at the disposal of Fritz was very incomplete, especially for very high latitudes, and although he admits himself that his method of calculation does not always give corresponding results, we may assume that the curves shown by him represent, in the main, the true relation of the frequency of the Aurora Borealis in the various parts of the northern hemisphere, even if later researches may cause some modifications in the position and form of the curves. It is probable, as I will show in another place, that the whole curve system is subject to various movements northwards and southwards.

Another question is how the values corresponding with each curve are to be interpreted. If we thus, for instance, on Fig. 10, look on the diagram of Scandinavia we

find the country crossed by the lines 100, 30, and 10. Does this mean that in the parts crossed by the lines there appear respectively 100, 30, and 10 auroræ? This may be Fritz's opinion, but the curves are in my opinion not to be interpreted thus. They do not represent the aggregate number of auroræ which *really* occur in a certain locality, but only the number which an *individual* observer *may*, in all probability, *see* in such a place.

These two points should be kept perfectly distinct; as it appears from the observations of the Aurora Borealis which have been made in North Europe at my suggestion during recent years, that the number of auroræ observed increases greatly with the number of stations and the extent of the territory. The auroræ *seen* and recorded by an observer are only a small number of those which really occur in that locality, and which *might* have been observed had all conditions been favourable. The principal cause of this is undoubtedly the clouds, which in a certain spot may hide a number of auroræ, but affect vast areas of continent very little. The different lengths of the time of observation of the various observers may also influence in this respect.

I will in support of this only give a few of the figures from the auroral observations which I collected for the winter half-year 1879–80.

If Greenland be indicated by G., Iceland by I., Scandinavia, north of 66° lat. N., by S^1., Scandinavia between 66° and 62°, by S^2, between 62° and 58° by S^3, south of 58° by D., and England by E., the following number of auroræ were observed in these countries—i.e.,

days on which auroræ were seen in the period August 1879 to May 1880.

G	I	S^1	S^2	S^3	D	E	S	S+D
140	73	123	97	112	37	15	185	198

If the figures relating to southern Scandinavia be compared to the values represented by Fritz's curves the difference becomes at once apparent. Through the district indicated by S^3, the line m runs equal to 30, but as may be seen from my observations, the number of auroræ seen during that period *was four times greater.* The district D is crossed by the line $m = 10$, and here too the number of auroræ observed is four times greater. It should also be remembered that the above figures refer to a year in which the Aurora Borealis, at all events in southern Scandinavia, was a comparatively strange phenomenon, whereas Fritz's curve is the average of years both poor and rich in auroræ.

In the district S^3, where a total of 112 auroræ were observed, lies Bergen (Norway), where, perhaps, the outlook for auroræ is keener than anywhere else in the world. Nevertheless, I have during the above-mentioned period not been able to discover more than 25 auroræ there, which is only 22 per cent. of the total referred to this part of Scandinavia.

It will thus be obvious that it is important to have as many observers as possible, and that the curves drawn by Fritz for an equal auroral frequency can only refer to the number which are *visible at an individual station.*

In my analysis of auroral observations for the period 1879–80, I have for the first time made an attempt to draw lines for equal frequency of auroræ within Scandinavia during the winter half year.

I have called these lines *isoaurores*, a name which may not be the most explicit, but which I fancy is better than that selected by Fritz. A reduced copy of my drawing is given in Fig. 11.

The lines are drawn for 5, 10, 20, 30, 40, 50, 60, and 70 auroræ during the period September 1879 to April 1880. As a basis the number of auroræ recorded at each of the 300 stations is not taken, but the number of all the *days* when auroræ were seen within a radius of sixty-two miles or one hundred kilometres of each station. Although this drawing must be considered the first of its kind I believe it is sufficiently interesting to merit a place in this work.

Similar comparisons for later winters I have as yet been unable to draw, on account of my sojourns in Lapland and Iceland.

On Fig. 10 there is a dotted curved line within the maximum zone, which is also drawn by Fritz. It indicates the line along which the Aurora Borealis is as a rule seen either in the south or north; outside it the former is the case, inside the latter. It is enclosed by the maximum zone, running very nearly parallel with it. I believe, however, that close researches will show that the two lines coincide, and that they also move simultaneously north and south.

As to the extension of individual aurora in space I am

at present unable to say much with confidence. Many auroræ seem to have only a small extension, but some,

Fig. 11.

particularly those of the maximum period, flare up over enormous portions of the earth's surface.

5.—*The Height of the Aurora Borealis.*

The study of the height of the Aurora Borealis above the earth's surface is, it will be easily conceived, of the greatest importance in understanding the nature of the phenomenon. Unfortunately the height of the aurora has always been, and is to some extent still, a moot point in natural science. There are of course not wanting estimates and observations relating to this question, but the general results of these, particularly of the earlier ones, are very contradictory. There seems, however, to be every probability of the problem being very soon solved.

As a basis for the measurements of the aurora, the arcs or the more pronounced solitary streamers, are generally selected when they have been exactly and simultaneously observed from two points situated some distance from each other, the apparent height or position in each place having been determined by measurements or comparisons with stars. In consequence, however, of the rapid shifting both of appearance and position of the auroræ, this method is difficult and unsatisfactory, and these drawbacks may to a great extent explain the very divergent results which have been obtained by the same.

In order to give an idea of the manner and principle of measuring the auroræ in their simplest form, I venture to describe the method I have at times been in the habit of following.

On March, 7, 1880, a great aurora was observed at 145 of the stations which I had established over the

southern part of Norway, the west coast of southern Sweden, and in Denmark. One of the characteristics of this phenomenon was a large, broad arc, or, perhaps more correctly, band, which for a long time spanned the sky from east to west. In Bergen, where my own observatory was established, it remained for some time in the Zenith, then moving a little to the south; but at the stations lying further north it was seen in the south, while at those south of Bergen it was seen in the north.

By its characteristic internal repose and slow motion, this remarkable band was especially suited to establish the identity of this aurora at the various stations, and to serve as a basis for its measurement. It had apparently, when in its most southern position, no connection with the types which appeared simultaneously in the north, the latter being streamers especially radiating, which it was impossible from their rapid change of form and appearance to observe connectedly at the various stations.

If the various reports of this auroral phenomenon be examined, not the slightest doubt will remain of the object seen being the same, i.e., that it was the *same* arc which was observed at the most southern as well as the most northern stations. The further we move southwards away from it the more the apparently observed height diminishes, until we find that at the most southern points it was seen merely as an ordinary low-lying arc. In Bergen no trace of an auroral phenomenon was seen south of the band in question, and the reports from the stations south of this place all agree that neither was any seen there. From this we may conclude with certainty that the auroral arc

observed in the zenith of the horizon at Bergen was the identical one seen at all the southern stations, and that the line of demarcation of the phenomenon seen from that place was the absolute southern extension of the aurora.

Before it is possible, however, from the observations before us, to measure the height of the arc, it is necessary to ascertain its direction and its position in space relatively to the localities on the surface of the earth, from which it was seen. In the main, the point of culmination of ordinary auroral arcs is in the direction of the magnetic north of the place of observation, and the arcs themselves follow approximately the magnetic parallels. I found, however, from careful calculations, that the culminating points of this arc deviated some 10° west from the magnetic meridian, and that its course or strike was at an angle of about 25° with the geographical parallel circles.

The calculation of the height of the arc rests on the following principle. If in Fig. 12, S and S′ denote two points of observation, C the centre of the earth, and P one point in the Aurora Borealis situated in the same perpendicular plane through S and S′, and whose angles above the horizon h and h′ have been determined at each station, and the longitude and latitude of each place is known, it is possible (by a well known trigonometrical formula, viz., $\cos d = \cos (l - l') \cos b \cos b' + \sin b \sin b'$ where l and l′ indicate the longitude and b and b′ the latitude of the two places, and d the distance or great circle between the two) to find the arc S S′ which is equal to the angle S C S′. From this again S S′ ($\frac{1}{2}$ S S′

$=\sin \frac{1}{2}$ S C S′) is found. Further $\angle$ $x = x' = \frac{1}{2}$ S C S′. One knows, therefore, in the triangle S P S′ the side S S′ and the angles P S S′ and P S S′ so that its other parts, as for instance P S, may be ascertained by means of some simple trigonometrical calculations. If P S is known, we further have, in the triangle P S C, S C which

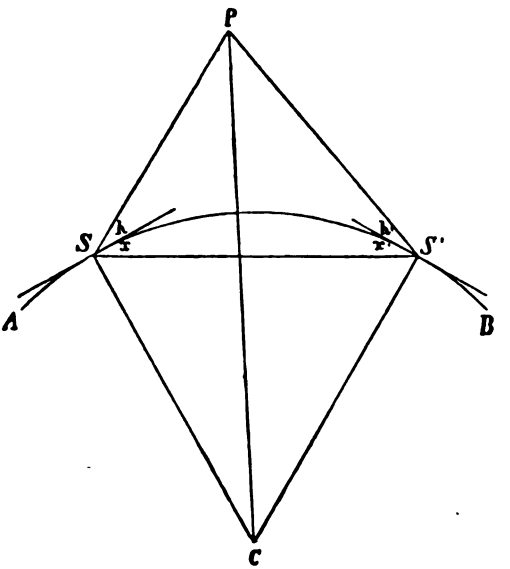


FIG. 12.

is equal to the radius of the earth and the angle P S C $= 90° + h$. From this P C is found, and, subtracting S C, the perpendicular height of P above the earth's surface is determined. Finally if $\angle$ or the angle P C S is ascertained, the point on the earth above which P is situated perpendicularly is found.

In practice the matter is, however, not quite so simple. The method presupposes thus that P lies in the same vertical plane as both points of observation, which would rarely occur, but still it retains its adaptability, even if P only indicates a point in the upper or lower edge of the auroral arc, the culminating point of which has been determined in both places, provided that these lie in the same plane perpendicularly to the longitudinal axis of the arc, or may, at all events, be referred to such a common plane.

It is however far more difficult to overcome another drawback. Provided that the arc has a perceptible thickness in relation to its horizontal breadth, those parts of the upper or lower edge of the arc which present themselves to the various observers, cannot always be referred to the same parts of the arc, in consequence of the circumstance that the apparent breadth, particularly with the lower arcs, is due to a combination of both the real breadth and thickness of the arc.

If a b c d in Fig. 13 represent the circumference of an arc observed from the points A B and C assuming that the line of demarcation of the arc north and south is parallel with the inclination needle, the point *a* will denote the upper (southern) edge for A and B, for C on the other hand *b*; and in a similar manner the lower (northern) edge is determined by the point *d* for A and B, *c* for C, &c. Now if the determination of the apparent height of the upper edge for A and C is taken as a basis for calculation, the height of the same cannot be ascertained therefrom, but the height of the crossing point of the lines A a and C *b* and so forth. A great

many other variations may also be met with according to the dimensions and position of the arc. Generally, however, when the arc lies on one side of both places of observation, the edges observed in the respective places are identical.

In the following simple manner I have succeeded in referring the various places of observation to the vertical

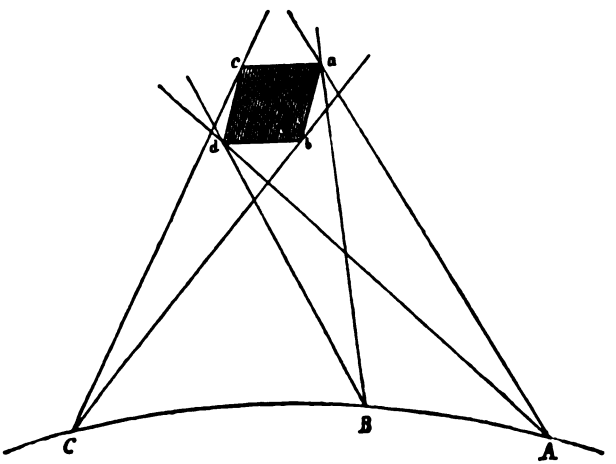
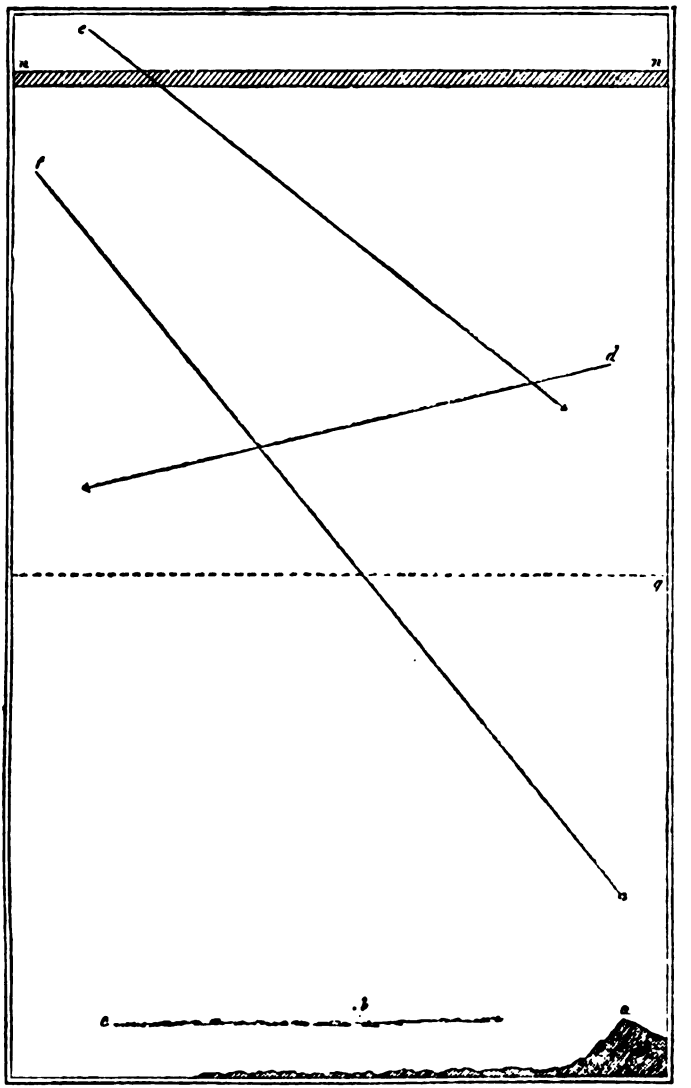


FIG. 13.

plane of Bergen, where my own observatory is situated, in order to find the arc S S′ in Fig. 12. The direction of the arc I have, in accordance with observations, let form an angle with the circle of latitude of 25°. I have constructed a map with the circles on a large scale on Mercator's projection, on which the various stations have been denoted. Through the place "Bergen" a straight line is drawn at an angle of 25° with the circles of

latitude, while the perpendicular distance of the various stations from this line has been determined by construction and direct measurements. The stations whose observations are so complete that the height of the arc above the horizon could be determined have been combined with Bergen. I have succeeded in forming nineteen such combinations. The heights of the arc calculated from the observations at these stations vary somewhat, but not very much, and if an average is taken we find that the value of the height of this arc above the earth's surface was most probably 91·3 miles, or 146·95 km. It further appears that the observations were not exact enough to obtain an estimate of the thickness of the arc, so that we can only accept the figure given above as an average one, i.e., an average of the distance of the uppermost and lowest layers from the surface of the earth.

If we compare the height arrived at in this case with those obtained through previous researches, we shall find that it agrees to some extent with the value of the height of the arcs measured in recent times. They differ, however, greatly from old ones. Thus, Professor Fearnley finds, through observing sixteen auroral arcs in Christiania, by an ingenious theoretical method for ascertaining the height of the Aurora Borealis from observations from *one* spot, that the average height in these cases was 125·2 miles or 201·5 km. Newton found, by the same method, that the average height was 130 miles, or 209·3 km., while Nordenskiöld, by a similar method, has come to the conclusion that it is 118·1 miles or 190 km. The French expedition established at Bossekop during



To face page 250.

FIG. 14.

1838–9 obtained no reliable statistics on this point, owing to the small distance between the two points of observation, viz., 9·7 miles or 15·6 km. But from the results obtained it seems that the height must be sought between 62 miles or 100 km. and 124 miles or 200 km.

In opposition to this, Bergman fixes the height at 468 miles or 753 km., Boscovich at 825 miles or 1328 km., and Mairan 485 miles or 780 km. More in correspondence with our result, Dalton found the height of the auroral arc to be 150 miles or 241 km., and Backhouse between 50 and 100 miles or 81 and 160 km. On the other hand, Franklin found, at Cumberland House (North America), that several auroræ which he measured had a height only of 7 miles or 11·3 km. In fact, the *savants* who have studied the Aurora Borealis in the Arctic regions appear to agree that it does not attain the height given above as the results of researches farther south.

I have here only mentioned a few of the very divergent values obtained in measuring the Aurora Borealis, but I do not believe it will be of any service to append more, as the values range from 0 to 1000 miles.

In Figure 14 I have attempted to illustrate the height of the Aurora Borealis referred to by me by comparing it with other well known heights. Below is drawn a profile of Norway from Bergen in a direction E. 25° N. The heights here range to upwards of 5000 feet. Above *n n* indicates the arc of the aurora in its height of 91·3 miles or 146·95 km. The thickness given is wholly approximate and probably too small. For comparison is inserted, *a*, the highest

mountain in the world (Mount Everest, 29,000 feet); *b*, the greatest height reached by man (Glaisher and Coxwell in their balloon on September 5, 1862, 37,000 feet); *c*, the estimated height of the cirrus clouds (30,000 feet); *d*, the plane of the August meteors, 71 and 55 miles or 115 and 88 km.; *e*, beginning and ending of the November meteors, 96 and 61 miles or 155 and 98 km.; *f*, the point of appearance and disappearance of the large meteor which was seen on March 4, 1863, in England, Holland, Belgium, and Germany, 83 and 16 miles or 134 and 26 km.); and finally, *g*, the hypothetical height of the atmosphere, 46 miles or 74 km.

With regard to the results of the measurements of the aurora which I effected during last winter at Koutokæino in conjunction with the stations at Bossekop and Sodankylä, I may be brief, from the circumstance that the observations made at the latter station are not to hand, while the material at my disposal requires a more careful analysis than I have as yet been able to bestow upon it.

I must, however, state that a preliminary examination of the observations made in the plane Koutokæino—Bossekop has led to the important discovery that the Aurora Borealis, at all events in this locality, lies in a plane about 50 to 100 miles above the earth. I have examined all the observations made simultaneously at the two stations, and have not found the slightest indication of the aurora descending to a level in which it would only be visible at one of them, while there seems to be no reason for assuming that the types observed were not identical, when due regard is paid to the difference in

the height above the horizon of the two stations.* The straight distance between Koutokæino and Bossekop is about 66 miles or 107 km.

I have, on the principle indicated in Fig. 12, made a series of preliminary measurements of the lower edge of auroræ observed at both stations, having selected only those where there cannot be the least doubt as to identity, from which I have obtained the following values in miles:—47·2, 49·6, 52·6, 58·2, 60·7, 61·0, 61·5, 62·1, 62·5, 66·5, 72·5, 77·3, 77·6, 82·0, 88·0, 90·0, 92·6, 101·7; (km.:—76·0, 79·9, 84·6, 93·6, 97·7, 98·2, 99·0, 100·0, 100·6, 107·0, 116·6, 124·4, 124·9, 131·9, 141·6, 144·9, 149·0, 163·6.) If the average of these eighteen measurements is taken, the average height of the lower edge will be 70·2 miles or 113 km., i.e., a result which is in perfect harmony with the later observations referred to above.

To give any definite results of the studies of the thickness of the arcs, the length of the streamers, &c., is, of course, impossible, until the material has been carefully sifted. I may here, in passing, observe that we must, in all estimates of the height of the Aurora Borealis be content with approximate figures; this lies in the nature of the case, apart from inaccuracies in the measurements which it is impossible to avoid. The Aurora Borealis has, in common with clouds, no absolutely defined and fixed line of extension, either downwards or upwards. We must, therefore, rest content with ascer-

* The researches of Professor Lemström at Sodankylä in Finnish Lapland, which seem to point in a different direction, I intend to discuss in another chapter.

taining only approximately the height of the plane in which the Aurora Borealis lies.

That the aurora generally appears at a height of 60 miles or 100 km. or more above the earth's surface does certainly not preclude the possibility of its appearance on some occasions much nearer the earth. In fact there are a considerable number of reports in our hands which imply that this is really the case. Thus, observers aver that they have seen auroræ below the clouds, in front of mountains and icebergs, and even on the ground itself. These assertions have been greatly doubted, as being the result of the imagination, or optical delusions, but, with what justice, I will not venture to say. For my own part I can only say that, during my long stay at Koutokæino, I had unfortunately often occasion to observe auroræ and clouds simultaneously, but although always paying the closest attention to this particular point, I have never even seen a fragment of an aurora in front of or below the clouds. Even the most intense development of light, colour, and motion occurred always above what seemed to be the very highest lying clouds.

When the entire material relating to the study of the Aurora Borealis has been collected from the various international circumpolar stations, sifted and carefully analysed, the question of the height of the Aurora Borealis will not, I believe, long remain one of the unsolved problems of nature. Until then the reader must remain content with the results I have indicated here.

6.—*The Periods of the Aurora Borealis.*

The Aurora Borealis has three distinct periods, viz.,

the daily, the yearly, and the eleven-yearly. I intend in this part to discuss these, according to my own observations and researches, supported by Prof. Fritz's data.

The daily period is apparent by a maximum of frequency and development which in most places in the globe occurs one to two, or three hours before midnight. This maximum seems, however, to occur *later* the nearer we approach the magnetic Pole. This will be clear from the following series, in which the figure in parenthesis denotes the geographical latitude and the other the hour when the aurora attains its maximum in the place named.

Prague (50), 8¾; Oxford (52), 9¼; Kendal (54), 9¾; Makerston (56), 9⅓; Upsala (60), 9½; Christiania (60), 10; Bergen (60), 9⅘; Bossekop (70), 10½; Pustosersk (70), 11–12; Quebec (47), 10⅓; Fort Carlton (53), 12¼; Fort Simpson (62), 12; Point Barrow (71), 13½.

For the Aurora Australis continuous series of observations are almost entirely wanting. It seems, however, from the fragmentary material which we possess, that the daily period for this does not differ from that of the Aurora Borealis.

The individual types of the Aurora Borealis seem, like the phenomenon itself, to be confined to periods, and to attain their greatest frequency and highest development at certain periods. Thus, it appears from the observation of the previously mentioned French expedition to Bossekop, that the arcs appear on an average at 7h. 25m.; the streamers at 8h. 26m.; the auroral clouds at 11h. 18m.; the auroral waves between 13h. 12m. and 13h. 53m.; the intensest colours at 10h. 11m., and the greatest brilliancy between 10h. and 11h.

The yearly period is distinguished by two maxima and two minima, both distinctly defined. This will be demonstrated by the following series of figures, which show the recorded monthly totals for Switzerland from 583 to 1874 (Fritz's catalogue); for Sweden, from 1700 to 1875 (Rubenson's catalogue); and for the Northern Hemisphere, from 502 to 1877 (Fritz's catalogue). The months are indicated in Latin numerals, I. meaning January, II. February, and so forth.

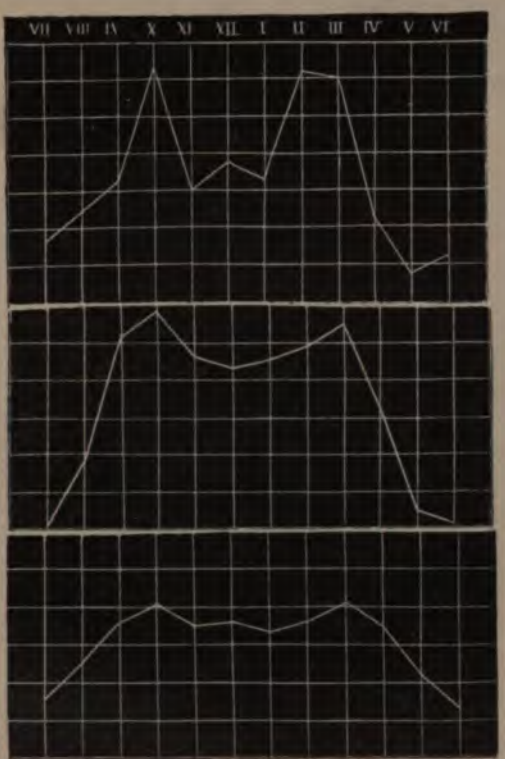
	VII.	VIII.	IX.	X.	XI.	XII.	I.	II.	III.	IV.	V.	VI.
Switzerland (Fig. 15).	12	18	23	45	21	27	21	44	43	16	6	9
Sweden (Fig. 16.)	25	365	991	1121	886	822	665	935	1043	633	89	5
North Hem. (Fig. 17).	707	1059	1571	1711	1499	1501	1482	1539	1799	1476	862	554

The law which these figures reveal will be further apparent by examining the corresponding Figs. 15–17, where for better comparison the monthly totals have been reduced to the same yearly sum.

In all three instances—and these might be augmented by many others--we find that the Aurora Borealis shows two maxima in its yearly course, occurring in September or October and in March or April, which are about equally marked. The case is, however, quite different with the two minima, at the solstices, as that occurring in the summer advances much further down than that in the winter. To some extent, of course, this may be due to the light summer nights over a great area of the earth, which prevent the aurora from being seen; but it appears from similar series for the Southern Hemisphere, that here, too, the minimum occurring in June to July advances further down than the corresponding one in December to January,

although the Southern Hemisphere has the longest night just in June and July.

If, however, the condition of regions nearer to the



FIGS. 15, 16, 17.

magnetic Pole be examined, we shall find another peculiarity of the yearly frequency curves. As an example, I append some figures from higher latitudes :—

	X.	XI.	XII.	I.	II.	III.
Smith Sound (Fig. 18).	1	7	10	17	11	2
Mossel Bay, Spitzbergen (Fig. 19).	12	23	28	16	14	7
Novaya Zemlya (Fig. 20).	1	3	10	11	13	4

This series is shown on Figs. 18 to 20, after being reduced to the same total. For these regions the conditions are such *that the frequency is greatest at the winter*

Figs. 18, 19, 20.

solstice and smallest at the equinoxes. Whether the curve again rises to a maximum in the summer months, is impossible to say, on account of the long Polar day, which renders the auroræ invisible.

Of the yearly, as well as the other periods, in the northern zone, I will speak further presently.

For a long time it has been known that the Aurora Borealis, at all events in many places of the globe, varies

greatly from year to year as regards frequency and development, in such a manner that, for instance, in Central Europe, it may be entirely absent for some years, and then recur for another series with great frequency and brilliancy. It was not until we had somewhat complete auroral records that it was possible to demonstrate that this variation follows fixed periods, and, what is far more important, *that these periods are connected with phenomena*

FIG. 21.

far beyond the earth's sphere, viz., the so-called solar disturbances. It is chiefly to Prof. Fritz too, who has the honour of having drawn up the most complete catalogue of auroræ for the whole globe, that we are indebted for the discovery of the eleven-year cycle and its connection with the periods of the sun's spots.

This varying period will best be seen from the lower curve on Fig. 21. It rises and falls in proportion to the number of auroræ in each year. It embraces the greatest

part of this century, and shows the number of auroræ in Central Europe between the 46th and 55th deg. of latitude N.

It will be seen at a glance that the frequency of the Aurora Borealis rises to a maximum during an interval of about ten years, and that the minimum periods lie about equally distant from each other.

By the aid of similar returns from other places on the earth, Fritz has found that the average maxima and minima for the whole earth, have occurred in the following years of the present century.

Maxima:	1804, ·5	1818, ·5	1829, ·9	1840, ·2	1850, ·1	1860, ·6	1870, ·9		
Minima:	1810, ·8	1822, ·2	1834, ·1	1843, ·8	1856, ·3	1865, ·6			

The average length of the period—from maximum to maximum or minimum to minimum—is 10·9 years.

In 1843 Schwabe demonstrated by his observations, extending over many years, that the sun-spots are subjected to a very nearly regular period of 10 to 11 years, in such a manner that their number rise from a minimum to a maximum in the course of 5 to 6 years, again to recede to a minimum through the same number of years. Since then scientists have been able to fix, with a fair amount of certainty, the sun-spot cycles during the present and last century, and as regards the former, the maxima and minima fell on the following years:—

Maxima:	1804, ·2	1816, ·4	1829, ·9	1837, ·2	1848, ·1	1860, ·1	1870, ·6		
Minima:	1810, ·6	1823, ·3	1833, ·9	1843, ·5	1856, ·0	1867·2			

The average length of the period is 11·1 years.

As had previously been shown to be the case with some of the terrestrial-magnetic phenomena, Fritz dis-

covered in 1862, that the Aurora Borealis is subject to the same period as the sun-spots, and that the greatest and least frequency of both occur simultaneously.

On Fig. 21 I have shown at the top the sun-spot cycles of the present century, and it will be seen that this curve is almost identical with the auroral one below. But the connection between the two phenomena is clearer still, when the above-mentioned periods of maxima and minima of each are compared. There is not, indeed, a perfect identity, but this cannot be expected; still, the deviations are not very great, and fall now on one, now on the other side.

How can this connection between what may be called a *terrestrial* phenomenon and *solar* disturbances be explained? Well, that it is one of those riddles which the scientist of To-day leaves to that of the Future to solve!

Besides the eleven-year period, some believe having discovered another one of about fifty-five years, to which both the Aurora Borealis and the sun-spots seem to conform. This point is, however, as yet so moot that its discussion would be merely hypothetical.

7. *The Periodical Movements of the Auroral Zone.*

It will be perfectly clear that it is chiefly observations from the Temperate Zone which have constituted the material for demonstrating the eleven-year period. But as regards the Polar regions, it has been assumed that either the Aurora Borealis also follows the same laws in these parts, or that it appears with the same force and same manner all the year round. Neither of these alternatives seem, however, to be right, as a series of observations pro-

secuted with great care during fifteen years at Godthaab, in Greenland, have brought me to the somewhat remarkable conclusion that, as regards the varying frequency of the Aurora Borealis at Godthaab, *the law seems to be the reverse of that ruling in southern latitudes.*

These researches, which were effected by Mr. S. Kleinschmidt, extend over a period from August 1865 to May 1880. The number of days with auroræ in the year, reckoned from August to May, were:

1865–66	66–67	67–68	68–69	69–70	70–71	71–72	72–73	73–74
97	112	65	84	45	61	32	47	73

1874–75	75–76	76–77	77–78	78–79	79–80
97	97	104	69	100	75

This series cannot, however, be accepted as giving the *exact* view of the relation between the varying frequency of the auroræ, because the state of the clouds would exercise a great influence on the visibility of auroræ. If thus the clouds vary greatly from one year to another, this circumstance would greatly reduce the number of auroræ. A closer study of the nebulous conditions at Godthaab, compared with the frequency of the auroræ, has caused me to consider that the number of auroræ decrease in proportion as the clouds increase in quantity. The above-recorded auroral totals must, therefore, be reduced to the same cloud unit, i.e., it must be calculated how great the number would have been had the nebulosity been the same every year. By this we obtain the values given under N. Under S. is given the relation between the sun-spots in the same year (July to June).

	1865–66	66–67	67–68	68–69	69–70	70–71	71–72	72–73
N.	86·2	91·3	67·4	80·9	51·7	56·5	32·0	46·0
S.	23·5	6·1	18·3	60·1	107·0	133·5	98·6	89·4

	1873–74	74–75	75–76	76–77	77–78	78–79	79–80
N.	78·4	97·0	95·0	102·0	73·0	85·2	83·3
S.	51·7	32·1	11·6	13·5	6·8	2·2	16·3

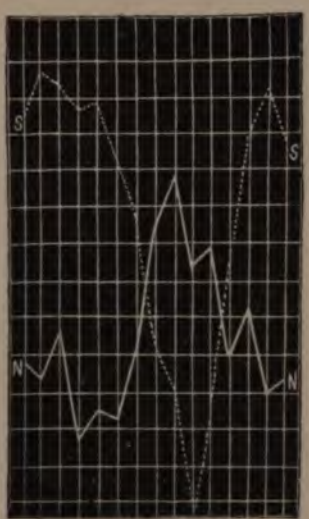


Fig. 22.

If the two series be compared it will be found that, *the law of relation between the frequency of sun-spots and auroræ is reversed.* This fact will be still more apparent from Fig. 22, where both series of auroræ and sun-spots are shown graphically.

The few series of observations which we possess from other Polar regions, and which I have been able to analyse, indicate, though incomplete, similar conditions.

As the greater part of the Godthaab observations were

made in the morning, I have not only used the auroral days for my researches—reckoned from noon to noon—but also examined evening and morning auroræ separately. The evening and morning auroræ lead, as regards the eleven-year period, to the same conclusion as the auroral days, i.e., that *the Aurora Borealis is scarcest under sun-spot maxima.*

With reference to the yearly period, I need only state here the monthly totals of evening auroræ, due allowance having been made for the nebulosity and unequal length of the months.

Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
87·0	133·5	133·9	136·1	129·5	125·6	98·7	35·2

These figures, which are shown in Fig. 23, demonstrate that, *the Aurora Borealis in the Polar regions has a yearly maximum about winter solstice.* It will, however, be noticed that the increase is not very great, compared with the figures of the nearest months on each side. Of the maxima towards the equinoxes, so conclusively proved for southern latitudes, there is no trace whatever here.

Weyprecht has advanced the theory that the auroral zone, i.e., the belt in which the Aurora Borealis is most frequent, effects a forward and backward movement in the course of the year, in such a manner that at the equinoxes it lies further south, by which the maxima of the Temperate Zone at these periods are explained, while it would, in a reverse way, lie further north at the winter solstice, which would then create the maximum occurring at that season in the Polar regions, and the winter minimum of southern latitudes. In view of this I have

analysed the Godthaab aurora on this point, and having also extended my researches to the other two periods for the aurora, I have obtained some very remarkable results.

Weyprecht rests his assumption chiefly on the relation, which varies month by month, between the number of auroræ in the north and the number in the south, for the locality in which he stayed during the Austrian Polar Expedition, which wintered very nearly right under the

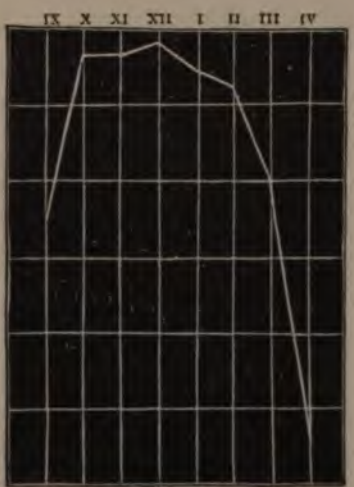


Fig. 23.

auroral zone. But such a distinction between auroræ in the south and auroræ in the north cannot be made with the Godthaab observations, as this place lies far north of the auroral zone, the greatest number of auroræ by far being seen in the south. I had, therefore, to follow a different method in finding the proportion between the auroræ which appeared in the south, and those which were seen in the Zenith, the north, or covered the whole

sky. By the same method we also obtain an idea of the greater or lesser proximity of the auroral zone to the place of observation, and its position in relation thereto.

My researches have led me to endorse Weyprecht's theory. I feel satisfied that, *the Aurora Borealis moves towards the autumnal equinox southwards, and then northwards, reaching its furthest northern limit about solstice. After this it again moves southwards, being in its most southern position at the vernal equinox, when the movement is again in a northerly direction.*

From this it follows that the two maxima occurring in the Temperate Zone at the equinoxes must approach each other more the further north the point of observation is situated. This is, in fact, the case. As some examples, I may mention that, whilst the two maxima occur in March and September in St. Petersburg, Åbo, Stockholm, Christiania, Worcester (Mass.), and New Haven; they occur in February and October in Aalesund, Newberry, Quebec, and Newfoundland; in December to January in Hammerfest; and in January at Fort Reliance. Very instructive in this respect are also the observations from the three Greenland stations: Upernivik, Jacobshavn, and Ivigtut. At Ivigtut, the southernmost of the stations, the yearly maximum must certainly be said to occur in January; but there is a second maximum towards the autumnal equinox. At Jacobshavn, eight degrees further north, there is but one distinctly marked maximum, in January, and at Upernivik, the northernmost of the stations, the maximum falls at the winter solstice, more marked and dominant than anywhere else in the world.

Another very important fact, discovered through these researches, is this, that, *while in the evening the auroræ are less frequent in the Zenith and further north than in the south, the reverse is the case in the morning.*

Thus at Godthaab the auroræ of the morning are three times more numerous in the Zenith than in the south, while under the evening auroræ their number is only three-sevenths of those in the south.

This important discovery proves that, *the auroral zone also travels in the course of the twenty-four hours by moving northwards in the night;* and this again explains the daily period demonstrated in lower latitudes, which shows that, *the aurora reaches its maximum a few hours before midnight, after which it gradually disappears.*

If this conclusion be correct, the daily maximum must occur later the further north the point of observation lies, and I have, in the foregoing examples, indicated that this is really the case.

If we, in a similar manner, consider the relation between Zenith and southern auroræ in the various years of the Godthaab researches, we obtain the interesting result that the percentages of Zenith auroræ in the main follow those of the auroral frequencies, i.e., *that at the periods of maxima at Godthaab, the auroræ which fall in the Zenith of this place or further north, are not only absolutely, but also relatively, more frequent than at the periods of minima.* And what deduction may be drawn from this? The deduction *that the auroral zone in the course of the eleven-year period makes a movement too, of such a nature that it lies further north when the sun-spots are in their minimum than in their maximum period.*

If this result be compared with what I have already propounded as to the eleven-year period in the Arctic regions, the interesting explanation will be obtained of the phenomenon, that this period in Greenland and similarly-situated places shows a reverse course to that in more southern regions. *The auroral maximum, occurring in the temperate regions simultaneously with the sun-spot maximum, is due to the auroral zone being then in its southernmost position, which again causes an auroral minimum in the polar regions, and, in a reverse manner, the auroral zone has its northernmost position when the sun-spots are in the minimum, which then causes an auroral minimum in the temperate regions and a maximum one in those around the Pole.*

All the three periods of the aurora, viz., the daily, the yearly, and the eleven-yearly, and the epochs of culmination, demonstrated as occurring at various seasons, are, according to the theory I have advanced here, due to one and the same cause, viz., *the movement of the auroral zone northwards or southwards.*

8.—*General Observations on the Influences, the Sound, etc., of the Aurora Borealis.*

In conclusion, I shall briefly touch upon a few more points which are connected with our subject.

About the middle of last century, Professors Hiorter and Celsius, in Upsala, proved that the magnetic needle becomes very restive under an aurora. Numerous researches in recent times on these magnetic disturbances, have confirmed the fact that to a great extent they are connected with this phenomenon, although the connection between the two is not so easily explained as the

discovery led one to suppose. This only is certain, that greatly extended auroræ are always accompanied by great magnetic disturbances, which generally embrace large areas of the globe. But there are, on the other hand, many proofs of weaker auroræ not always causing a disturbance, and that the latter may occur when there is no aurora visible at all. To demonstrate a closer connection between these and the individual types and phases of the aurora has often been attempted, but with little success. There are, however, several circumstances which seem to indicate that the perturbations of the magnetic needle become more and more violent the intenser and nearer the aurora is, i.e., the higher it ascends into the sky.

These magnetic disturbances are still one of the most puzzling and inexplicable problems of nature. I will only here mention that these disturbances have, like the Aurora Borealis, a daily, a yearly, and eleven-yearly period, which are all more or less connected with those of the aurora. There are, besides, indications of the magnetic needle showing movements in the Polar regions reverse of those in southern latitudes, in a manner similar to those of the Aurora Borealis, which I have just described.

Of the proofs demonstrating the intimate connection between the Aurora Borealis and those forces which create the terrestrial magnetic phenomena, I will only advance two, viz., firstly, that the highest point of the auroral arc everywhere on the globe falls almost in the line of the magnetic declination needle, and secondly, that the centre of the auroral corona lies always in that point of the heavens which would be struck if the inclination needle

was lengthened upwards. The latter circumstance is also proof of the auroral streamers following the direction of the inclination needle.

Whether the Aurora Borealis really is connected with the *electricity* in the air is still a problem; but it should be noted that great and intense auroræ always cause severe derangement of the telegraphs, by the wires being under the influence of electric currents, which counteract, and sometimes suspend, those by which messages are transmitted from one spot to another. Sometimes the whole telegraph system of a country may be rendered inoperative for a while by intense auroræ, if the disturbing current itself be not used for dispatching messages, which indeed may be done. The telegraphic disturbances follow the same period as the sun-spots, and as regards geographical frequency, seem to follow the same law as the Aurora Borealis. In the Norwegian telegraph system they are, therefore, very frequent, in fact, in the northern part of the country they are phenomena of daily occurrence.

As is generally known, thunderstorms cause similar disturbances; but the latter are, when thus created, confined to a comparatively limited area, and of short duration; they are, as a rule, however, far more violent in character than those caused by the Aurora Borealis.

With regard to the relation between the so-called telegraphic disturbances, the Aurora Borealis, and the terrestrial magnetic forces, some exceedingly interesting and important researches have, during the last four years, been carried out in Scandinavia, of which I will give a brief account.

Since July, 1, 1881, I have caused regular records to be kept at 44 telegraph stations in Norway and Sweden of all disturbances occurring in the conductors, both as regards time, duration, force, and direction. Of course, these observations will only become of real scientific value when we have a series of them extending over many years before us; but still I have thought that it might be of interest even at this early date to attempt to ascertain if these telegraphic disturbances are subject to the same yearly and daily periods of motion as those of the Aurora Borealis, and the terrestrial magnetic forces of the earth. As I am at the present moment unable to give an exhaustive account of these researches at all stations, I have provisionally chosen four of them for the purpose of learning the results of their observations.

The names and positions of the four stations are:

Kistrand	70° 25′ Lat. N.	25° 13′ Long. E.
Lödingen	68° 24′	16° 1′.
Trondhjem	63° 27′	8° 5′.
Bergen	60° 24′	5° 20′.

The period over which these researches extend is from July, 1881 until June, 1884. As the Norwegian stations do not work during the night, the records refer to the day only, i.e., from 7 A.M. until 12 midnight.

I have, firstly, selected the days of each month on which telegraphic disturbances occurred, *having, however, expunged all those disturbances which according to the reports may be attributed to thunderstorms.*

The values obtained as well as the totals of each month were as follows:—

Lödingen.

Month.	1881—82.	1882—83.	1883—84.	Total.
July .	3	4	3	10
Aug. .	6	3	1	10
Sept. .	9	2	3	14
Oct. .	8	11	1	20
Nov. .	8	14	4	26
Dec. .	2	5	0	7
Jan. .	5	4	0	9
Feb. .	10	10	3	23
March	9	9	6	24
April .	10	4	3	17
May .	7	3	2	12
June .	2	6	0	8
Year .	79	75	26	180

Bergen.

Month.	1881—82.	1882—83.	1883—84.	Total.
July .	2	1	3	6
Aug. .	0	3	2	5
Sept. .	5	1	1	7
Oct. .	5	3	4	12
Nov. .	6	10	3	19
Dec. .	6	6	1	13
Jan. .	3	1	2	6
Feb. .	3	9	0	12
March	10	4	4	18
April .	9	3	1	13
May .	4	2	0	6
June .	3	1	0	4
Year .	56	44	21	121

Kistrand.

Month.	1881—82.	1882—83.	1883—84.	Total
July .	1	2	8	11
Aug. .	0	12	3	15
Sept. .	7	12	11	30
Oct. .	14	20	6	40
Nov. .	10	22	3	35
Dec. .	13	8	3	24
Jan. .	5	7	0	12
Feb. .	7	10	9	26
March	13	16	4	33
April .	25	6	12	43
May .	19	4	3	26
June .	14	5	5	24
Year .	128	124	67	319

Trondhjem.

Month.	1881—82.	1882—83.	1883—84.	Total.
July .	7	5	10	22
Aug. .	4	8	3	15
Sept. .	10	6	3	19
Oct. .	15	11	6	32
Nov. .	11	16	6	33
Dec. .	14	6	5	25
Jan. .	12	7	1	20
Feb. .	16	10	4	30
March	18	8	7	33
April .	14	4	2	20
May .	17	2	1	20
June .	6	6	3	15
Year .	144	89	51	284

I have graphically shown on Fig. 24 the three-yearly totals of the months. Both the figures and the diagram show clearly that the periods of the telegraphic disturbances *are identical with those of the Aurora Borealis*, i.e.,

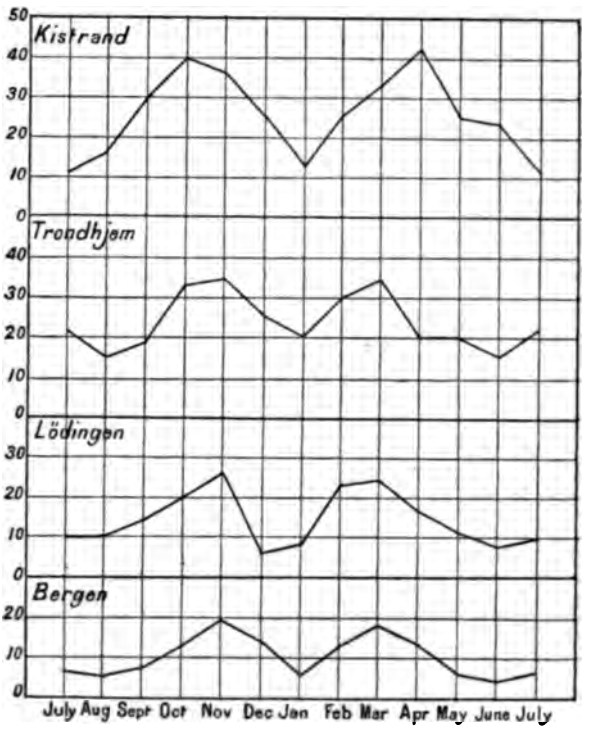


FIG. 24.

that their minima occur at the solstices, and their maxima at the equinoxes. Particularly remarkable is the demonstration of a minimum at the summer-soltice, as the Aurora Borealis is at that period invisible on account of the light nights in the North.

The decided manner in which the motion of the yearly period becomes manifest, shown in the four lines on Fig. 24, is remarkably striking when we recollect that the material analysed only covers a period of three years.

The four tables give also some idea of how frequently these telegraphic disturbances occur in Norway as compared with other countries in Europe. In the yearly totals there is a steady decline, which indeed corresponds with the decrease of auroræ in Norway during the last few years. During the three winter months (1884–1885) I have now resided in Christiania, I have only seen a couple of faint luminosities; and from a communication I have received from Reykjavik, dated November 29, I learn that up to that date no aurora of any magnitude had been observed in Iceland either.

In a few years we shall, I believe, probably also be able to demonstrate that the telegraphic disturbances coincide with the eleven-year period of the Aurora Borealis.

In order to determine the daily period, I have ascertained how often during the three years, in every hour from 7 A.M. to 12 midnight, disturbances were noticed (excluding also here all those attributable to thunderstorms). The figures I have obtained, which are, it seems, very remarkable, are given in the following table.

Hour.	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Kistrand . . .	42	117	135	139	141	137	122	128	133	155	177	191	227	247	238			
Trondhjem . .	24	68	84	91	88	88	81	91	75	93	120	123	137	136	138	77	69	61
Lödingen . . .	11	30	39	48	47	41	36	41	43	57	70	80	91	96	100	70	61	54
Bergen	9	23	23	24	28	29	27	43	37	40	42	47	52	61	77	51	61	59

These are reduced graphically in Fig. 25, and they show that the telegraphic disturbances have a marked maximum between 8–9 P.M. There are besides (with the exception

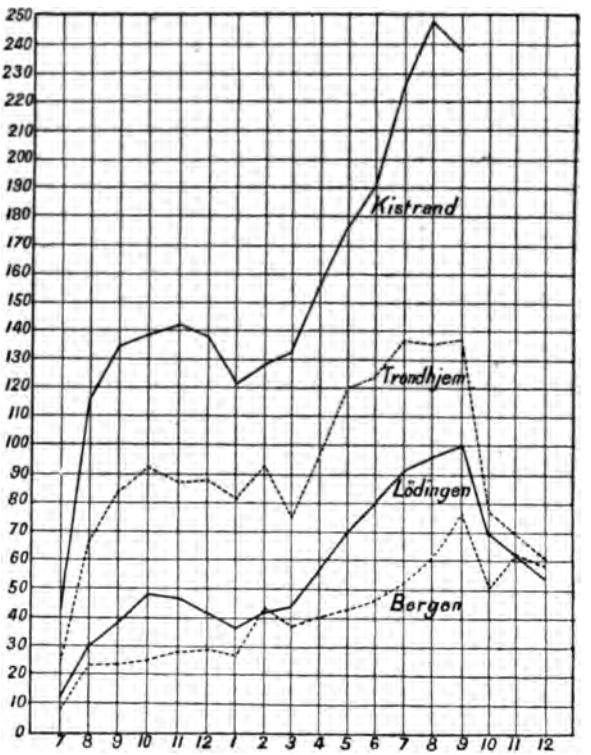


FIG. 25.

of Bergen) indications of a maximum between 10–11 A.M. and a minimum between 1–2 P.M.

With regard to the question, whether the Aurora Borealis affects the weather, much superstition prevails, a matter which is not surprising if we remember how fond weather prophets are of referring changes to unnatural

causes. If thus the scientist takes the trouble of ascertaining the opinion of the rustic of various countries, or even provinces, he will be told that here the Aurora Borealis causes north wind, there south wind; in one place storm, in another calm; here cold, there heat; in fact, the most opposite meteorological phenomena. Far would it be from my thought to deny that any connection exists between the Aurora Borealis and the weather; on the contrary, I believe it is rather probable; but this connection is not so apparent that it can be proved by a few years of unscientific experience; any scientific research this question has as yet not been subjected to. We may certainly assume that certain conditions of the weather may be more favourable for the creation of an aurora than others, and perhaps, also, that certain auroræ influence, or are at all events connected with, coming weather; but still, it is impossible to assert that the Aurora Borealis produces such or such weather; this is conclusively shown by the fact that regions where auroræ occur daily, as for instance, Koutokæino, have every variety of weather.

The cirrous clouds sometimes form into narrow, parallel streaks, running right across the sky, which, on account of the perspective, appear to meet in two opposite corners of the horizon. These so-called *Polar bands* many believe are somehow related to the Aurora Borealis, or the forces on which this phenomenon depends. However that may be, these streaks seem, too, as regards frequency, to follow the yearly and the eleven-yearly periods of the Aurora Borealis.

The effect of the moon on the aurora is shown thereby,

that the latter is rare when the moon is full, and most frequent when new, but the reason is doubtless that the moonlight in many instances outshines the feeble glimmer of the Aurora Borealis. Even when the aurora is sufficiently strong, and projects over the moon's disk, its light disappears within a radius of 5° to 10° around the moon; but in the appearance of the latter there is no change. Any other connection between the Aurora Borealis and the moon I do not believe to exist. The ever-changing distance of the moon from the earth does not affect the Aurora Borealis.

There is no point relating to the Aurora Borealis which is more disputed than *the sound* which some say accompanies the phenomenon, at all events at certain times. It is described as of various natures, viz., cracking, whizzing, and hissing, from nearly every part of the world where the Aurora Borealis is visible, and the faith in the "sound" is as orthodox among the Eskimo of Greenland and the Lapps of Finmarken as the Tchuctches of New Siberia. Even Capt. Dawson and his party, the English Circumpolar Expedition to Fort Rae (1882), assert that they distinctly heard the sound one night when passing up the Great Slave Lake; and in latitudes much further south too, people aver having heard the noise. Well, the remarkable part of this question is, that all other scientists, who have sojourned for a length of time in northern regions, *have never heard the slightest sound which could with any amount of certainty be ascribed to the Aurora Borealis.*

Without absolutely refusing to believe in the possible existence of such a sound, I fancy that there must be

some acoustic deception or misunderstanding which has created this belief in an auroral sound. During my stay at Koutokæino I was daily surrounded by people who believed as firmly in the sound as in the Holy Gospel, yea, at Bossekop they even told me that they did not think there was any Aurora Borealis at all until it whizzed, and still I maintain, that of all the intense auroræ I have observed in various parts of the Arctic regions, and which I am sure I have watched with more attention than is generally bestowed on them, *every one has been perfectly silent.*

It will hardly be of interest to the reader to detail all the theories which have been advanced for explaining the origin and nature of the Aurora Borealis, particularly as not a single one of them has succeeded in being generally accepted, and in giving an explanation of the various peculiarities which observation and research have proved to be part of the phenomenon. Apart from the ancient theories, which may now be considered of little importance, two have been advanced in modern times which may be mentioned. The one is the so-called cosmic theory, according to which the Aurora Borealis should be produced by the earth's entering into clouds of ferric dust during its passage through space, the molecules of which would, under the influence of the terrestrial magnetism, gather in certain conformations, producing the various forms of the aurora and its position in space. This theory appears, however, to have no other adherents than its originators.

The other theory is that interpreting the Aurora Borealis as an electrical phenomenon, and it cannot be

denied that the resemblance between an electric discharge in a chamber of rarified air and certain forms of the aurora is so striking that it is impossible to assert that no relation exists between the two phenomena. The electrical theory which seems to deserve most adherence is that advanced by Professor Edlund, of Stockholm. He refers the Aurora Borealis to that class of electrical phenomena which have been denominated *unipolar induction.*

If a magnet, which is encircled by a conductor, revolves round its axis, and a point of the same near one of the Poles be connected with a point half-way between each, by means of a copper wire, an electric current is created by the rotation which runs between the equatorial and the polar zone, and whose direction and force depend on the direction and rapidity of the rotation. If we now apply this case to the earth itself, considering that the globe is the rotating magnet with a good conducting envelope, viz., the crust, the atmosphere, which in its lower parts is a bad but in the upper ones a good conductor, becomes the final link of connection of the circuit between the equatorial and the two polar zones. And under the earth's rotation the positive electricity at the Equator will be ejected from the earth, and the upper atmosphere by degrees become charged with positive electricity, whilst the earth remains negative, and further, the positive electricity in the upper atmosphere will move from the Equator to the Poles, and, oppositely, the negative electricity in the earth will move from the Poles to the Equator. There will, in fact, be created an electric *tension* between the atmosphere and the earth, and when this becomes too

great a *fusion* takes place. At the Equator and in the temperate zone this fusion will be effected under sudden discharges, which are called *thunder-storms*, whilst at the Poles they will be more continuous and even, viz., as *an Aurora Borealis.* The reason why the sudden discharges occur in the tropical and temperate regions is that every discharge occurs easiest in the direction of the inclination needle, which at the Equator is horizontal, whereby a discharge can only take place when the tension between the earth and the upper atmosphere becomes so great that it conquers the small conductive force in the lower atmosphere; it is then demonstrated by the electric spark, viz., the lightning. The nearer, however, the Pole is approached the more the needle inclines, and the easier is therefore an even discharge towards the earth.

Professor Edlund further shows that these pacific discharges must preferably take place in a belt which surrounds the magnetic poles at some distance, i.e., *in that zone which I have just described as the maximum or auroral zone.*

I have concluded my task of describing the Aurora Borealis, of informing the reader what we know and what we do *not* know of the phenomenon. Will man ever decipher the characters which the Aurora Borealis draws in fire on the dark sky? Will his eye ever penetrate the mysteries of Creation which are hidden behind this dazzling drapery of colour and light? Who will venture to answer! Only the Future knows the reply. But nevertheless the student toils yard by yard along the fatiguing road of research, in the hope—

maybe vainly—of some day reaching the much-coveted goal.

Lovely celestial display! Before your fascinating mysterious play, in which the enigmatic forces of Nature flood the heavens with light and colour throughout the long Polar night, the golden sunsets of the Pacific Ocean, the gorgeous flora of the Tropics, the resplendent lustre of the gems of Golconda, must pale. Lovely celestial display!

END OF VOL. I.

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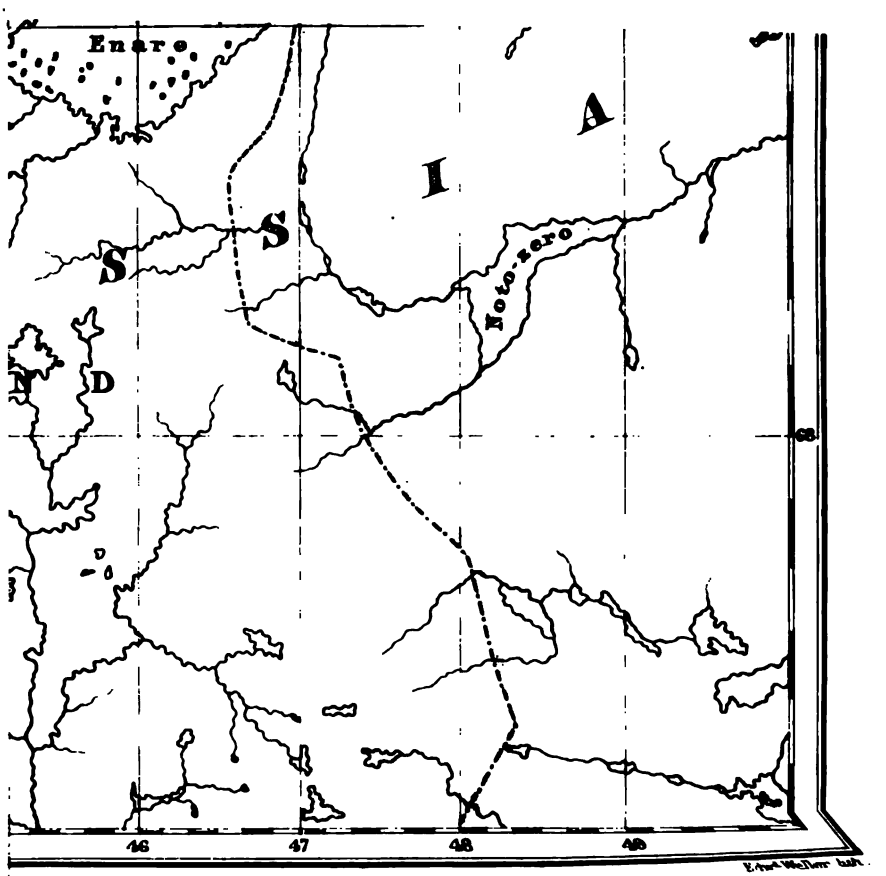
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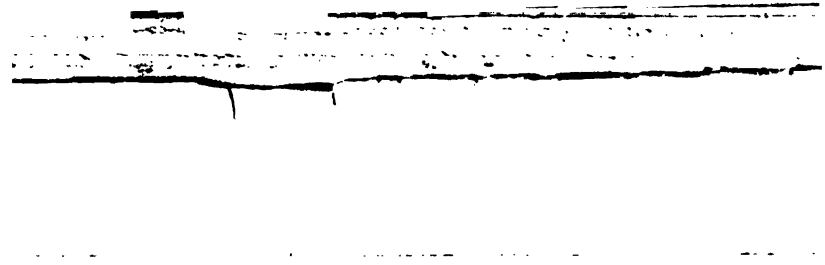

GUIDE TO THE MAP.

The following List of Places contains all names on the map within two longitudes and two latitudes.

▨ signifies Town.
† „ Church-village.
∘ „ Trading-station, Mountain-hut, Lapp settlement.

Lat.	Long.	
69	40	∘ Elvebakken
		† Bossekop
		† Kaa Fjord
		∘ Gargia
		Beskades
		∘ Suolovuobme
		∘ Pingisjavre
		Neidogortsje
	41	Alten River
		∘ Ladnijavre
	43	† Karasjok
	45	† Utsjoki
	47	∘ Bugönæs
		† Kirkenæs
		† Boris-Gleb
		Pasvik River
	48	∘ Elvenæs
68	36	Torne Träsk
	38	Kilpisjärvi
		∘ Vittangi
	39	† Karesuando
	40	† Koutokæino
		Bæljasvarre
		∘ Autzie

Lat.	Long.	
		∘ Galanito
		Gargovarre
		∘ Aidejavre
		∘ Syvvajärvi
68	40	∘ Palojoki
		∘ Pultanen
	41	∘ Sitschajavre
		∘ Neckela
		† Hätta
		∘ Kyrö
		∘ Puoledaibala
		∘ Gätkesuando
		∘ Torrasiepi
	42	∘ Debasto
	44	Ivalojoki
	45	† Enare
	48	Notozero
67	39	† Vittangi
	40	∘ Muoniovarre
		Torne River
		† Pajala
	41	∘ Ravhalla
		∘ Pöntsa
		† Muonioniska

Guide to the Map.

Lat.	Long.	
		Muonio River
		• Kengis
	42	• Jokkela
		• Sirka
		† Kittilä
	43	• Tepsa
	44	† Sodankylä
71	41	• Fruholmen
	42	Hjelmesö
		• Gjesvær
	43	North Cape
	45	North Kyn
		Knivskjærodden
70	37	Vandö
		† Karlsö
	38	† Skjervö
		Arnö
	39	† Hasvik
		† Loppen
		• Ox Fjord
	40	Sörö
		Seiland
		Stjernö
		• Komag Fjord
		• Korsnæs
		Alten Fjord
		• Jupvig
	41	† Havösund
		Rolfsö
		⊠ Hammerfest
		Kvalö
	42	Maasö
		Magerö

Lat.	Long.	
		† Kistrand
		Porsanger Fjord
		• Laxe River
	43	† Kjelvik
70	44	Sværholtklub
		Laxe Fjord
		† Lebesby
	45	† Kjölle Fjord
		Kjorgosh Njarg
		† Tanen
		Tana River
	46	• Finkongkjeilen
		Tanahorn
		Tana Fjord
		• Stangnæs
		• Nyborg
		† Næsseby
		• Latnæringen
		Vargak Njarg.
	47	⊠ Vadsö
		Varanger Fjord
	48	⊠ Vardö
69	36	Kvalö
		Ringvadsö
		⊠ Tromsö
		Maals River
	37	Renö
		† Lyngen
	38	Lyngen Fjord
		• Skibotn
	39	Kvænangen Fjord
	40	† Talvik

7.50
Wals